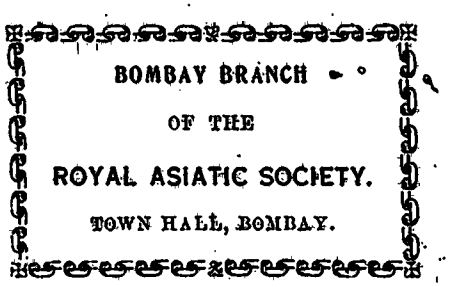
Agriculture Dept.
Punjab
Report on the operations
1919-20 to 1922-23
Part I

00134234



Digitized with financial assistance from

Government of Maharashtra

on 01 February, 2020

25/2/3

Report on the Operations of the Department of Agriculture, Punjab, for 1919-20.

Revised List of Agents for the Sale of Punjab Government Publications.

In the United Kingdom.

Constable & Co., 10, Orange Street, Leicester Square, London, W.C.

Kegan Paul, Trench, Trübner & Co., Limited, 68-74, Carter Lane, E.C., and 25, Museum Street, London, W.C.

Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.

T. Fisher Unwin, Limited, No. 1, Adelphi Terrace, London, W.C.

P. S. King & Son, 2 & 4, Great Smith Street, Westminster, London, S.W.

H. S. King & Co., 65, Cornhill, and 9, Pall Mall, London.

Grindlay & Co., 54, Parliament Street, London, S.W.

W. Thacker & Co., 2, Creed Lane, London, E.C.

Luzac & Co., 46, Great Russell Street, London, W.C.

B. H. Blackwell, 50 and 51, Broad Street, Oxford.

Deighton Bell & Co., Limited, Cambridge.

Oliver & Boyd, Tweeddale Court, Edinburgh.

E. Ponsonby, Limited, 116, Grafton Street, Dublin.

William Wesley & Son, 28, Essex Street, Strand, London.

On the Continent.

Ernest Leroux, 28, Rue Bonaparte, Paris, France.

Martinus Nijhoff, The Hague, Holland.

In India.

The Manager, Imperial Book Depôt, Delhi.

Gulab Singh & Sons, Mufid-i-'Am Press, Lahore.

Manager, Punjab Law Book Depôt, Anarkali Bazar, Lahore.

Rama Krishna & Son, Book-sellers and News Agents, Anarkali Street, Lahore.

Honorary Secretary, Punjab Religious Book Society, Anarkali, Lahore.

L. Labhu Ram, Book-seller, Ludhiana

N. B. Mathur, Superintendent and Proprietor, Nazir Kanun Hind Press, Allahabad.

D. B. Taraporevala, Sons & Co. Bombay.

Thacker Spink & Co., Calcutta and Simla.

Newman & Co., Calcutta.

R. Cambray & Co., Calcutta.

Thacker & Co., Bombay.

Higginbothams, Limited, Madras.

T. Fisher Unwin, Calcutta.

V. Kalyanaram Iyer & Co., 189, Esplanade Row, Madras.

G. A. Natesan & Co., Madras.

Superintendent, American Baptist Mission Press, Rangoon.

A. H. Wheeler & Co., Allahabad.

REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB.

For the year ending 30th June 1920.

PART I.

LIBRARY
OF THE
BOMBAY
BRANCH
OF THE
ROYAL ASIATIC SOCIETY

134234
dc

Lahore:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRINTING, PUNJAB.
1920.

00134234

Proceedings of His Honour the Lieutenant-Governor, Punjab, in the Department of Revenue and Agriculture, No. 29815, dated 24th December 1920.

READ—

Letter No. 491—50-H.-1, dated 13th November 1920, from the Junior Secretary to Financial Commissioners, Punjab, forwarding, with the remarks of the Financial Commissioner the annual report on the operations of the Department of Agriculture in the Punjab for the year ending 30th June 1920.

REMARKS.—The Punjab Agricultural College at Lyallpur has continued to grow in popular esteem and to command the confidence of the agricultural community, but, accommodation being limited, a large number of applicants had to be refused admission. The increased interest of landowning classes in agricultural education is indicated by the fact that out of a total of 268 applicants, of whom only 54 could be admitted, 202 were agriculturists. The construction of a new hostel for the College has been sanctioned, and the question of strengthening the staff has been referred to the Government of India. Affiliation to the Punjab University where a separate faculty of agriculture has been instituted adds to the activities of the College and widens the field for recruitment of students. It is hoped that with increased accommodation and increased staff the doors of the College will be flung wider to students interested in agriculture, and that so large a number of applicants will not be turned away, disappointed. The vernacular class, the teachers' class, and the rural economy class continued to do valuable work.

2. Mr. James Mackenna, lately Agricultural Adviser to the Government of India, collected a sum of money to perpetuate the memory of the late Mr. Hugh Southern, Deputy Director of Agriculture, who lost his life in the war, and it has been decided to place a brass tablet in the College library and spend the interest (Rs. 70 annually) in awarding prizes in Biology, Chemistry, and Botany.

3. Sir Edward Maclagan awaits with interest a fuller description of the scientific investigation that has been continued in connection with the reclamation of barren '*bara*'

land in the Montgomery District. The Agricultural Chemist has continued his researches in connection with distribution of soil moisture, and it will be interesting to watch how far his conclusions are supported by the practical tests of the Drainage Board. The scheme of soil survey for the Sind Sagar Colony has been postponed in favour of a survey in the Nili Bar.

4. The year under review was unfavourable for all cottons, but although the American varieties suffered more than the indigenous 4-F continues to be popular with the agricultural community. The advantages of inter-culture and sowing in lines have been appreciated, and nearly 30,000 acres were thus sown this year. The experiments of Mr. Milne on the comparative merits of 4-F and 285-F American cotton seem to show that the latter variety is better in yield and quality and has a stronger power of resisting drought than the former, but caution will be needed in accepting this conclusion as definite. The area under Punjab 11 wheat has risen from 97,000 acres in 1916-17 to 377,500 acres during the year under review. Although according to Mr. Robert's analysis at the Lyallpur Farm the average yield of Punjab 11 was higher than that of Punjab 8-A by 14 seers per acre, the latter is reported to be the better yielder at Gurdaspur and Hansi Agricultural Stations. The zamindars prefer 8-A to Punjab 11 because it has a hard amber-coloured grain and is much better for making country bread. In milling and baking tests also it has proved superior to Punjab 11. But the Director is no doubt right in saying that evidence with regard to the relative merits of these two varieties wants most careful investigation with regard to soil conditions, irrigation, climate and manuring.

5. The movement for the creation of demonstration farms is spreading. Land is being acquired for demonstration farm at Hoshiarpur and Government has agreed to contribute a sum not exceeding Rs. 50,000 towards the Khalsa College Farm. The wheat and cotton seed depôts in the Province are doing valuable work on a large scale in supplying pure seed. The Lieutenant-Governor agrees with the Financial Commissioner that such depôts should not be run for profit and that an explanation should have been given of the very large item of profit (Rs. 1,27,961) from the depôt at Lyallpur.

The scarcity of labour and rise in wages produced a keen demand for labour-saving devices, but owing to high prices sales of imported implements were not large. The locally manufactured cheap implements, such as the Bur harrow, the Lyallpur hoe, the kharif and rabi drills are popular in the Punjab which is a province of small peasant proprietors, and it may be trusted that their advantages will be largely advertised through the efforts of the agricultural associations in different districts.

6. Despite the difficulty of obtaining materials well-boring has been satisfactory and the percentage of success has risen from 77·6 to 84·3. The mechanic borer lent to the Army Department returned from Persia and efforts are being made to replace the plant sent to Bushire. Mr. Miller Brownlie devoted his attention to the design of a suitable power-boring machine for Punjab soils, but no definite result has yet been achieved. The Lyallpur elevator is working under the management of Messrs. Clement Robson, it ran its trial trip on the 15th of May and began to receive wheat from the public on the 14th of June 1920. Messrs. Clements Robson and Co. are ready to take the entire responsibility of seeing wheat from the elevator into a ship's hold, if asked to do so.

The experiment of posting prices of cotton at all important markets in the Province has been continued for another year in order to aid the growers to secure the full value of their crop. Although no auctions were held by the Co-operative Department the Agricultural Department arranged for 16 auctions, but owing to the failure of American cotton on a large area, the quantity auctioned was less than half of that auctioned last year.

7. Mr. Jacob has shown how difficult it is to estimate the outturn of a standing crop within an error of ten per cent. even though the knowledge of past yields, manurial and other treatment and the number of waterings may be available. He is naturally sceptical about the accuracy of the crop forecasts, which are prepared with much less care and caution and under less favourable conditions.

It is not easy to earmark a progressive sum of money in the agricultural budget for several years in advance, as the financial conditions of the Province cannot be foreseen

with any degree of certainty. If in past years a retrenchment has been necessitated by financial stringency it should not be forgotten that circumstances were peculiar. Government has always given due weight to the needs of the Agricultural Department and will not stint money, whenever it is available.

8. The progress achieved by the department during the last two years has been conspicuous and is in no mean measure due to the scientific training and practical enthusiasm of Mr. Jacob. The Lieutenant-Governor desires to express his sense of the loss to the department and the Province entailed by the departure of Mr. Roberts who is leaving the service after eleven years of solid and unassuming work at Lyallpur to become Manager of the British Cotton-growing Association's farm at Khanewal. He is glad to think that in this position his experience and advice will not be entirely lost to the Province. The Province is unfortunate in simultaneously losing Mr. Faulkner, whose six years' collaboration had marked him out as successor to Mr. Roberts as Professor of Agriculture but who has been offered an appointment as Director of Agriculture in Nigeria. Mr. Wilsdon's work has been of a very high order and his reversion to the Educational Department, when it comes, will be another heavy blow to the Agricultural Department. Sir Edward Maclagan takes this opportunity of congratulating the Director and other officers of the department on the success that has attended their operations during the past year.

ORDER.—Ordered that a copy of these remarks be forwarded to the Senior Secretary to the Financial Commissioners, Punjab, for the information of the Financial Commissioners, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India in the Department of Revenue and Agriculture.

By order of H H. the Lieutenant-Governor of the Punjab,

E. JOSEPH,

Revenue Secretary to Government, Punjab.

1875 CS—529—12-1-21—SGPP—Lahore.

No. 491-50-H-1.

FINANCIAL COMMISSIONERS' OFFICE :

Dated Lahore, 13th November 1920.

FROM

KHAN SAHIB MIAN ABDUL AZIZ,

Junior Secretary to the Financial Commissioners, Punjab.

To

THE HON'BLE MR. E. JOSEPH, I.C.S.,

Revenue Secretary to Government, Punjab.

The Hon'ble Sir John Maynard, K.C.I.E, C.S.I., I.C.S.

SIR,

I AM directed to forward Part I of the Annual Report on the Department of Agriculture, Punjab, for the year ending 30th June 1920, with the Financial Commissioner's Review thereon.

2. I am to add that Part II of the Report (Annual Experiment Record) has not yet been received from the Director of Agriculture.

I have the honour to be,

SIR,

Your most obedient servant,

ABDUL AZIZ,

Junior Secretary to the Financial Commissioners, Punjab.

169 FC—511—14-11-20—SPPG Lahore.

Financial Commissioner's review of the Agricultural report for 1919-20.

1. The number of applications for admission to the Agricultural College (268) was a record one, and only one-fifth of the number could be admitted. As 35 out of the 54 had passed the Matriculation Examination in the 1st division, the College evidently commands a good type of student. The result of the first University examination for the Agricultural degree was good. 15 out of 20 qualified for the degree, and 2 were required to present themselves again in certain subjects. Work with the teacher's class (for instruction in Agriculture in Schools) continues successfully. Out of six Chiefs' College men on the rolls, one has successfully completed his two years' course, four are studying for the Agricultural Degree and one has gone to England for further study. Proposals for the institution of a M.Sc. course in Agriculture have recently been laid before the University. Large extensions of accommodation in the College and its hostels are contemplated: and when these are carried out the doubling of numbers will be feasible. The course for soldiers at the Jullundur Demonstration Farm is an interesting extension of Agricultural Education.

The Agricultural College.

2. The Financial Commissioner looks forward with very much interest to Mr. Wilsdon's report on his investigations in the distribution of soil moisture. He notes that Mr. Jacob expresses doubt of the soundness of the tentative conclusion that the lining of canals will only postpone the date of waterlogging. It is to be noted in this connection that the Drainage Board is arranging for a practical test, never hitherto applied under satisfactory conditions and on a sufficiently long channel, of the actual effect of lining.

Study of soil moisture.

3. In paragraph 8 the Director of Agriculture has stated that from Mr. Milne's data his own estimate was that the loss caused in the colonies from growing 4-F cotton was 70,000 bales, the total estimated crop being over 200,000 bales. If the Financial

Important crops.

Commissioner has understood correctly what is meant, Mr. Jacob intends to convey that the deleterious effect of the dry climate in August and September 1919 was particularly serious in the case of 4-F American Cotton. But the datum, with which comparison is made, does not appear. Some other type of American cotton might have suffered less in these peculiar conditions: but as no other type of American cotton is grown on anything like the same scale, it is not possible to judge how another type might have behaved under a similar strain. Taken as it stands, and unexplained, the Director of Agriculture's remark on page 13 has the appearance of shaken confidence in the type which the Department has been pressing with such apparently good results. He is on safe ground, however, in the conclusion that there must be no assumption of the final superiority of the 4-F type. According to the Financial Commissioner's view there can be no absolute finality in the selection of a particular type, and there is always a possibility of something better. In the meanwhile the fact, mentioned on page 21 of the Report, that cultivators who grow both American and Desi cotton last year side by side appear to think that the former is at bottom the better crop, is significant. American 4-F has done well in Mesopotamia.

In wheats, Punjab-11 and Punjab-8-A evidently run one another very close in point of yield on the Lyallpur Farm. 8-A has the advantage at Gurdaspur and Hansi, while the milling and baking tests appear to show that something better than Punjab-11 is possible. The next step will presumably be more extensive field trials of the 8-A type, and till these are made judgment must remain in suspense. In the meanwhile it is noteworthy that sowings of Punjab-11 have reached 3,77,500 acres. Mr. Jacob has done a service to statistical criticism in pointing out the considerable number of duplicate plots which are required to prove a one maund superiority by the methods of the experimental farm.

In view of the forthcoming report of the Sugar Committee it becomes important to decide provisionally how far the attention and resources now largely concentrated upon the undoubtedly profitable crops, wheat, cotton and oil-seed, should be diverted to sugar. There seems to be real reason for doubting whether the climate of the Punjab outside of the Ambala Division is suitable, in the economic sense, to

sugar, and the poor yields of gur are probably due to something more radical than bad cultivation and bad methods of extraction.

Sale of seed.

4. The Financial Commissioner understands that the value of seed at the seed Depôts is debited at its actual purchase price, and that it is sold at the market value at the time of sale. The market value of seed at sowing time must always tend to be high, and this fact is the guarantee against loss on seed depôt operations. The very large item of profit (Rs. 1,27,961) from the cotton seed depôt at Lyallpur is presumably due to some exceptional cause, the sale figure being nearly three times the amount of the purchase money, and an explanation seems called for, as these operations are not normally run for profit. The allotments (Rs. 4,19,000) made in the year under report show how extensive this business in pure seed now is.

Sale of imported agricultural implements.

5. The falling off in the sale of *imported agricultural* implements is clearly due to the war and post-war rise in their price. On the other hand the excellent work done in the local adaptation of cheap implements by the co-operation of the Agricultural Engineer and the Assistant Professor of Agriculture is illustrated by the figures of sale of implements manufactured by the department.

The Lyallpur Elevator.

6. The working of the Lyallpur Elevator, under the management of Mr. Owen Roberts, of Messrs. Clements Robson, will be watched with much interest. From June 20th to August 30th it had taken in 49,301 and discharged 18,586 maunds. It is understood that the maximum capacity is 100,000 maunds.

Outturn of wheat.

7. It is instructive to learn that the estimates of outturn of wheat made by experts erred by percentages of 27 to 38, when tested by actual weighment, though conditions favoured accurate estimates. As the Director of Agriculture has remarked, this fact is conclusive as to the value of the present forecasts of yields, which are made with far less care and far less science than these.

Agricultural Engineer.

8. It is satisfactory that the percentage of success in well-boring has risen from 77·6 to 84·3. Completion of the various works in progress during the year was delayed for want of apparatus ordered from England. Mr. Miller Brownlie, Agricultural Engineer, proceeded on leave towards the close of the year. It is expected that on his return from leave he will proceed further with his attempt to evolve designs for a power-boring machine to suit Punjab soils. If he is successful in this, the work of well-boring in the Province, will be advanced much more quickly.

Entomology.

9. Mr. Afzal Hussain was appointed Entomologist in the beginning of the second quarter of the year. His report on Entomology and Sericulture is printed as Appendix IV. The Director considers that he has shown great enterprise and marked ability. A good beginning has certainly been made, and the attention devoted to the study of the parasites of bollworm promises good results.

Sericulture.

10. The number of districts in which sericulture was practised rose from 8 in 1918 to 12 in 1920. The total seed imported and distributed rose approximately by 20 per cent., while the number of men who took up rearing rose from 165 in 1918 to 301 in 1920. The progress made is gratifying particularly after the great set-back on account of last year's failure. The Financial Commissioner is drawing the Director of Public Instruction's attention to Mr Afzal Hussain's remark that sericulture is a good source of income for poorly paid teachers.

Provincial Board of Agriculture.

11. The important questions discussed at the first meeting of the Provincial Board of Agriculture included the provision in the province for Intermediate Agricultural Education, the starting of additional cattle farms for the Dhannie, Dajil or Montgomery breeds, and the desirability of encouraging the sale of water on a volumetric basis, particularly to co-operative societies or to big zamindars.

The question of co-operative canal irrigation has aroused considerable interest and the Financial Commissioner has suggested to the Chief Engineer the initiation of an experiment. The idea is to form Co-operative Irrigation Unions, some of which will deal through their constituent societies

with whole distributaries and some with one or more villages on particular distributaries. The supply of water direct by the department to irrigators in the areas for which these Unions are formed will cease and the Department will authorise the Unions to sublet or sell the water. Of course the experiment will not be possible unless all the irrigators agree.

Agricultural budget.

12. War conditions have a good deal to say to that unevenness and apparently capricious character of the budget provision for agricultural expenditure which the Director of Agriculture has criticised. That money should have been withdrawn from expenditure, even on so profoundly important a subject as agriculture, in 1914-15 and in 1918-19, will surprise no one who remembers how the world was shaken in those two epochs. What the figures given by Mr. Jacob do show is a surprising growth of the belief in the value of expenditure on Agriculture, and an increased provision for it in a proportion far greater than the growth in the resources of the province. The provision in 1919-20 was more than sixfold that of 1910-11. The Director of Agriculture's proposed determination beforehand of the future budget figures, rising to 49 lakhs in 1924-25, might be of great advantage to the Province; provided that there were no other departments of the administration having growing requirements, and that the accidents of war, famine, and natural calamity could be eliminated from calculation.

Notice of officers.

13. During his officiating charge of the Department now coming to a close Mr. Jacob has shown the scientific spirit and a lively sense of the duty of expansion. His schemes of improvement have effected a real advance. The Department will be the poorer for the loss of Mr. Robert's wise caution and judicious progressiveness, but it is hoped that as Manager of the B. C. G. A. cotton growing lease he will continue to co-operate with the Department which he has served so well. The Financial Commissioner desires also to express his appreciation of the valuable work done by Messrs. Milne, Wilsdon, Faulkner and the other officers noticed by the Director of Agriculture. The report which was due with Government on October 15th is very late, and has not even now been received by the Financial Commissioner except in proof. Difficulties with the Press are presumably responsible for the delay.

169FC—511—14-11-20—SGPPLahore.

Annual report of the Department of Agriculture for the year ending 30th June 1920.

Part I.

Section I.

The report.

1. The new features of the present report are—

(1) Part I has to be printed in octavo size—*vide* Punjab Government No. 15876-Judicial of 11th May 1920.

(2) A glossary of all vernacular names has been appended as desired in Punjab Government No. 11110-R., of 8th April 1920.

(3) An index has been added. This ought to make information much more readily unearthed from the reports than it is at present.

(4) The reports of each of the experts in Part II, the Annual Experiment Record, are being bound up separately as well as in a single volume.

I am glad that Government has permitted part II of this report to be printed in quarto, as before.

Another 1,500 words have been added to the length of the report as the former limit of 500 words for the Assistant Professor of Entomology was quite insufficient for the new Entomologist and he had to be allowed 2,000 words like other heads of sections at the Lyallpur College.

The staff.

2. I officiated as Director throughout the year.

Mr. Faulkner returned from combined leave on 14th November 1919.

Malik Sultan Ali, who was appointed in the place of Mr. Southern and was under training at Lyallpur from 2nd September 1918, took over the charge of the Gurdaspur circle on the afternoon of 6th April 1920.

The Hansi farm remained under the charge of Sardar Darshan Singh except from 20th April 1920 to 9th June 1920 when he went on privilege leave. Maulvi Fateh-ud-din, Extra Assistant Director of Agriculture, officiated as Deputy Director *vice* Sardar Darshan Singh.

Mr. Afzal Hussain, I.A.S., joined as Entomologist at Lyallpur on 30th September 1919.

Mr. Miller-Brownlie proceeded on 7 months' combined leave from the afternoon of 8th May 1920 and Mr. P. A. McCormack, a retired Executive Engineer of the Public Works Department, is carrying on the duties of the Agricultural Engineer to the Punjab Government.

Mr. Milne went on 7 months' combined leave making over charge of his duties to Lala Jai Chand, Assistant Professor of Botany, on the afternoon of 4th June 1920.

Twelve new posts have been recently added to the cadre of Agricultural Assistants which now stands at 69.

The cadre of mukaddams has been provincialised.

The Agricultural College.

3. The increase in the number of applications for admission to the College has continued, while the difference between the number received from agriculturists and non-agriculturists has considerably increased in favour of the former. The figures for the last 4 years are as below :—

Year.	Applications.			Admissions.		
	Agriculturist.	Non-Agriculturist.	Total.	Agriculturist.	Non-Agriculturist.	Total.
1917 ...	78	124	202	23	16	39
1918 ...	100	125	225	37	17	54
1919 ...	173	92	265	47	9	56
1920 ...	202	66	268	50	4	54

The decrease of 2 in the number 'admitted' this year, has thus been explained by the Principal :—"The correct number for which we really have accommodation is about 40. Owing to the large number of applications we have admitted more. Each year we have tried to keep the number definitely not in excess of 50 as we cannot properly deal with more. Actually we have never quite been able to do so owing to uncertainty and late arrival of 'special' students from Native States and foreign provinces. We

have succeeded in keeping a little nearer our number this year than last."

Government has sanctioned the construction of a new hostel for the College, to accommodate initially 133 and eventually 200 students.

All the external examiners have reported favourably on the standard of teaching and the ability of the students. The following statement shows the results of the College for the last 7 years :—

Year	Class.	Number examined.	Number passed.	Agri-culturist.	Non-Agri-culturist.	Total.
1914 ...	3 years' course...	10	9	4	5	9
1915 ...	Ditto. ...	14	14	6	8	14
1916 ...	Leaving certificate. 3 years' course ...	19	19	7	12	19
1917 ...	Ditto.	20	20	12	8	20
1918 ...	Leaving certificate.	34	34	26	8	34
	4 years' course...	6 — 40	6 — 40	2 — 28	4 — 12	6 — 40
1919 ...	Leaving certificate.	14	14	11	3	14
	4 years' course...	4 — 18	4 — 18	3 — 14	1 — 4	4 — 18
1920 ...	Leaving certificate.	18	15	13	2	15
	4 years' course...	20 — 38	17 — 32	10 — 23	7 — 9	17 — 32

The figures show a welcome increase in the number of agriculturists as compared with non-agriculturists turned out since 1917.

The 1920 4-years class was examined by the Punjab University, for the first time, and it is satisfactory to note that out of the 20 students sent for the examination, 17 were declared successful—3 were placed in the first, 11 in the second, 1 in the third Division, and 2 came in compartment.

The vernacular course at Lyallpur admitted 26 students, and the Rural Economy class consisted of 18 students of whom 2 were Assistant Commissioners, 2 Extra Assistant Commissioners, 2 Inspectors of Co-operative Credit Societies, 2 Sub-Inspectors and 10 Zilladars.

The teachers class turned out 20 teachers who will teach agriculture in selected middle schools.

The sinking of the tube well for the college is in progress. The masonry work is nearly complete, and as soon as the 18" casing pipes which have been indented for from England are received, boring will be taken in hand.

The Agricultural Adviser to the Government of India has allotted an annual sum of Rs. 65 for the award of Southern Memorial prizes at the college and proposals have been sent up to Government to award 4 prizes in the form of books on the results of the 1st year examination. A brass tablet bearing Mr. Southern's name will be put up in the College library.

The annual value of the internal scholarships awarded at the College has been raised from Rs. 4,362 to Rs. 6,000, and the proposal for the award of a research scholarship of £250 for the study of agriculture abroad has, I understand, been referred to the Government of India. This year's research scholarship tenable for 2 years in India has been awarded for the study of "Rice and its cultivation" to Sardar Khan.

The Drill Havildar has left the college as he was dissatisfied with the emoluments which we could offer him.

The following fees for private analyses are now charged at the College, as sanctioned by the Financial Commissioner (No. 720—22-1 of 31st August 1920) :—

Analyses of agricultural products, including soils, manures, etc.	Rs. 15 to Rs. 45, according to the nature of the work.
Analyses for industrial applications.	Rs. 20 to Rs. 60, according to the nature of the work.

Section II.—Experts' reports.

Economic Botany.

4. *Milling and baking tests of wheat.*—In 1918 Mr. Milne made tests on 1,500 maunds, 15 seers of Pusa-12 and of various Punjab wheats in the Delhi Flour Mills. In November 1919 these tests

were repeated on 3,574 maunds of 8 A, 8-B, Pusa-12, Punjab-11, 14, 17, 9-C, 17-B, 20-C, and crosses 2 and 3 at the Pioneer Flour Mills, Shahdara, through the courtesy of Rai Girdhari Lal, the Managing Agent, and Mr. W. Hare, the Mill Manager. To both these gentlemen the thanks of the Department are tendered.

The bushel weights of the wheats above ranged from 63 for Punjab-11 to 65¼ for 8-A. As was noticed last year the bushel weight gives a strong indication of the percentage of straight-run flour, so that this result alone suggests that the wheats in question are of good milling quality, a bushel weight of 62lbs being considered of fair quality. Refractions, excluding skins removed by the whizzer, and the dust which could only be removed by water were from 1·26 to 1·51 per cent. The conditioning does not seem to have been satisfactory, as except for Punjab-11 and Punjab-14 all the wheats were under or over-conditioned, and therefore it is impossible to draw conclusions in favour of any one wheat from the percentage moisture absorbed. The dryness of the wheats, from 4 to 7·8 per cent. of water, before conditioning is notable. Punjab-11 was the driest, and, *ceteris paribus*, most likely to be immune from weevil attack. Mr. Milne, however, throws doubt on the accuracy of the moisture determinations. The differential milling loss due to more or less flour sticking in the machinery in the long pathway from first break to flour bag, has also made the calculation of the percentage of useful products obtainable from the different types of wheat very dubious. Once again Mr. Milne has had to fall back on the personal judgment of the miller for a determination of straight-run flour. The estimates compared with those of Mr. Ball in 1918 are as follows :—

	Percentage of straight-run-flour.	
	Mr. Ball in 1918.	Mr. Hare in 1919.
8-A ...	... Up to 75	72—74
8-B ...	... Up to 75	72—74
Punjab-17	... 73 or 74	73
Punjab-11	... 70	70
Pusa-12...	... 68 — 70	68—70
Punjab-14	... 68 — 70	68—70

It is most disappointing that a proper test could not be carried out, but it is clear from experience at the Shahdara

mills last year and in the Delhi Mills in 1918, that it is impossible to expect mill managers to free their machinery sufficiently for an accurate quantitative test to be carried out, and I agree with Mr. Milne that a Midget mill is required for tests on the Lyallpur Farm itself.

The baking tests carried out through the kindness of Colonel Davis, A. D. S. and T., Rawalpindi, are of interest. As compared with results last year, the weight of bread made per 100 lbs. of flour was as follows :—

Type.	*Bread weight per* 100 *lbs. of flour.*	
	1918.	1919.
8-B	144·8	142·0
Punjab-17	141·3	140·6
8-A	142·9	140·0
Punjab-14	137·9	139·6
Pusa-12	136·8	138·2
Punjab-11	144·2	139·2

It will be noticed that all but 2 of the flours (those from Punjab-14 and Pusa-12) show a drop in the bread weight, Punjab-11 in particular having yielded 5 fewer lbs. of bread from 100 lbs. of flour. The results are probably due to uneven conditioning and variations in the methods of baking. 8-B, which Mr. Humpheries classed first, stands first both in this year's and last year's baking tests.

Other work done by Mr. Milne is referred to elsewhere.

Agricultural Chemistry.

5. Mr. B. H. Wilsdon remained as Agricultural Chemist throughout the year and continued the lines of work noted on in the last annual report, experiments on a theory of soil moisture and soil colloids, osmotic pressure in soils, nitrogen fixation, green manuring, sullage and bara reclamation experiments being the chief lines of work.

Soil moisture.—Mr. Wilsdon says he has obtained an equation for the distribution of moisture in an unsaturated soil. The solution presumably gives the equilibrium distribution, in itself a result of immense importance. The lower boundary condition is a saturated soil, but I do not know what humidity, temperature and wind velocity have been assumed for the upper boundary condition. It is, as every one who has dealt with mathematico-physical problems knows, the boundary conditions which introduce the greatest difficulties. The problem is, in my opinion, the most

important one in the whole range of scientific agriculture, and Mr. Wilsdon's paper will be awaited with interest.

The conclusion which Mr. Wilsdon draws, truly only a tentative one, that lining of canals will only postpone the date of waterlogging, seems, in general, to be unjustified, as with a smaller rate of seepage equilibrium with the drainage and evaporation losses will naturally be attained with a lower water-table.

Punjab soil survey.—A proposal for a soil survey of the Punjab, beginning with the Thal was worked out by Mr. Wilsdon and forwarded to Government but has not so far been adopted. The scheme could equally well start with the Sutlej valley, and in view of the fact that this project has been given priority over the Sind-Sagar, this will be the proper course to take. The survey of already cultivated areas is an integral part of any soil survey scheme.

Bara reclamation.—Heavy applications of gypsum have made the soil more friable, but the only crop which has grown at all has been wheat, and that has produced scarcely more than a maund of grain per acre on the average. Whether the effect of the gypsum is mainly physical is perhaps doubtful, and it is noteworthy that, according to Hilgard, Calcium Sulphate stimulates the nitrifying organisms to more than double the extent of the other alkaline sulphates and very much more so than chalk (*vide* results quoted in Schwarz's Causal Geology, page 87).

In square 73, which is mainly 'bari' 5 maunds of grain were grown. Except in square 78, the crop, whether *san* or *guara*, grown for green-manuring was almost an entire failure.

So far, therefore, no economic results have been obtained, and it would be premature to expect them. The arrival of the second set of Fowler steam tackle will allow of more rapid progress in deep machine ploughing.

Green manuring and Nitrogen fixation.—Details will be found in part II. The results of green manuring in increasing the yield of wheat appear to confirm those of last year, the effect being due largely to the effect of the crop on the soil texture, equal doses of nitrogen in an artificial manure having nothing like the advantageous result of

guara. In stiff soils artificial manures led to depressing effects in grain yield in 4 cases out of 6. The relative increases of straw, even where green manuring is beneficial are generally markedly greater than the grain increases.

Mr. Wilsdon finds the average nitrogen fixation as 3·5 per cent. for the whole of the Province. His results epitomised are (rough averages) :—

Nitrogen in lbs. per acre in top 9 inches.

	1918.	1919.
Heavy loam	47	48
Light loam	61	62
Sandy (barani)	50	56

Thus in 1919 the sandy soils seem to have fixed most nitrogen. In any case the amount present in Punjab soils is far greater than the average of English soils where sand, loam and clay have an average nitrogen content of 12½, 25, and 25 lbs. per acre in the top 9 inches, and 120 lbs. per acre in the top 24 inches is spoken of as unusual (*vide* Russell's Soils and Manures, page 43).

Sullage experiments.—The land is still uneven and probable errors are large. Mr. Wilsdon also says that lodging of wheat has introduced uncertainty in the yields. He proposes to grow sugarane in future. Statement III, Part II, shows that in small plots, land which received undiluted sewage had the lowest yield, while in the area of big plots the land getting pure canal water had the lowest yield. Nothing can be deduced from this except the fact that on this land sewage was not very useful. Mr. Wilsdon points out how rapidly denitrification has taken place, especially in the plots receiving full and ¾ sewage. In all cases nitrates have disappeared entirely from the soil by June, when the recorded data cease. Nitrates disappeared first in the ½ sullage plot. I cannot understand this result.

General.—Mr. Wilsdon has appropriately commented on the growth of routine work, and the likelihood of its interfering with research. It cannot be too clearly grasped that a scientific department is so only in name if its officers' main energies are dissipated in attending to petty administrative questions. The danger of this is very palpably increasing, and it would be better for the department to

close down than that its true functions should be ignored. Mr. Wilsdon's abilities do not deserve to be thus prostituted.

Agricultural Engineering. Well-boring.

6. The number of wells bored during the year has increased, as compared with the last year, from 349 to 360 and the percentage of success from 77·6 to 84·3. The well-borers and mates have returned from Persia, but not so the boring equipment. The plant ordered from England has not yet arrived.

Tube wells.—The following works are in progress:—

1. Jallalabad in the Ferozepore District.
2. Lyallpur College.
3. Muzaffargarh (Date-palm gardens).
4. Lahore Veterinary College.
5. Bahawalpur Civil lines.

Except in the case of Bahawalpur, where the work was only started in February 1920, the completion is being delayed for want of pumps which have been ordered from England. The Date-palm tube well will be finished very shortly.

The Agricultural Engineer is also trying to evolve designs for (1) a power-boring machine to suit Punjab soils; (2) a Bhusa-making plant; and (3) a bullock cart.

Mr. Faulkner has carried out a fresh series of tests on Gibbs 1·5 cusec module, the data of which fall fairly closely on to a surface of the second degree, and enable the range within which the module is effective to be determined after exclusion of accidental errors.

Entomology.

7. Lala Madan Mohan Lal was in charge of the section from 1st July 1910 to 30th September 1919, when Mr. Afzal Hussain was appointed Entomologist. Mr. Afzal Hussain has sent an interesting report for the Annual Experiment Record (Part II), but as it has reached me only on the 9th September, long after the report is due to the press, I am unable to do more than make a few superficial remarks.

Boll-worm.—The results tabulated in tables I, II and III, showing the percentage of boll-worm attack on the Farm, in Lyallpur, and in other parts of the Punjab, are of particular importance in view of the complaints made in 1919 as to

the failure of cotton. Of the examinations made Americans suffered more from boll-worm than *desis* in 14 cases, while *desis* suffered more in 9 cases. In one instance the incidence was equal, this was in September 1919 in Ferozepore. Though not conclusive it seems that in 1919-20, 4-F. was slightly more susceptible to boll-worm than *desi* cotton, but the failure of American cotton in the colonies is not to be attributed to boll-worm (*vide* Economic Botanist's report printed in Part II). Mr. Afzal Hussain has devoted much attention to studying the life history of parasites of boll-worm, a very desirable investigation, and a far wiser course than merely distributing numbers of parasite boxes without knowing exactly the benefits derived from them. Many cotton pests are referred to in the report.

Mango-hopper.—The mango-hopper, Idiocerus Spp. still does a lot of damage. The observation that it winters in the bark of the tree, sugggests that possibly winter spraying of the tree might be useful. The pest is said to be prevalent in Gurdaspur, Hoshiarpur, Lahore and Sargodha. A power-spraying machine, which will enable the tops of the trees to be reached, has been ordered from America.

Parasites.—This appears to be a highly suggestive line of work. This may be said to be the inverse problem to that of, say, trypanosomiasis in man and beasts, and the discovery of a deadly parasite with a few immune carriers, would go far to solve the problem of the destruction of insect pests.

Weevil.—Mr. Afzal Hussain has given figures indicative of the seriousness of the damage due to weevils. My own experience with the imported chari seed last year showed how very dangerous it is to buy weevilled seed, and the Agricultural Assistant who was deputed to examine the seed before despatch let the Department down badly. The chari seed stored at Hoshiarpur was more than decimated by weevils though fumigation with such strong poisons as Carbon di Sulphide and Prussic acid was resorted to.

General.—Sericulture is dealt with below. Mr. Afzal Hussain has shown great enterprise and has well-marked ability. He will not always be able to get all the money that is necessary for the development of his section, but I hope that in time the required laboratories, insectory, and

equipment for entomological work will become available. Lala Madan Mohan Lal's work has been good, and he should be capable of benefiting largely by his training in England.

Sericulture.

8. *Sericulture.*—Six hundred ounces of silkworm seed reached here at the end of October 1919, and were kept at Simla for hibernation till the end of January. The results of the 1919-20 season have been encouraging. The following table shows the work done by the Department during the last 3 years :—

Year.	Total seed imported and distributed.	No. of men who took up the rearing.	Yield of dry cocoons per ounce of seed.	Average price realised per ounce of seed.	Price per maund of dry cocoons.	No. of districts in which sericulture was practised.
	Ozs.		Seers.	Rs. A. P.	Rs.	
1918 ...	506	165	6 to 20	20 9 4	120 to 190	8
1919 ...	472	206	½ to 5	3 5 4	190 to 200	9
1920 ...	600	301	6 to 17	32 5 7	227	12

Mr. Afzal Hussain, the Entomologist, has taken seriously to the work of sericulture, and has done much to place on a sound footing the silkworm industry, which received a great set-back on account of last year's failure. It may be mentioned here that the nett loss on account of the late arrival and the consequent bad germination of last year's seed was Rs. 1,472-7-9. Seed that had cost Rs. 3-10-0 an ounce, had to be sold at Re. 0-8-0 to Rs. 2-10-0 an ounce, and about 75 ounces did not produce any silk at all.

Sheikh Ghulam Sadiq imported 400 ounces (the same as last year) and distributed them amongst his own rearers. No details of yield or price realised have been supplied by him to the Department.

The Salvation Army imported no seed in the year under report and has apparently ceased to take any interest in the spread of sericulture. The Simla Silk School is defunct. All this is probably due to the departure of Commissioner F. Booth Tucker from India.

One thousand ounces were ordered for the coming season in June, but the Entomologist is so sure that the demand will be greater that I have cabled for another 500 ounces. The

question whether sericulture should be under the Agricultural or the Industrial Department is under consideration. I have proposed the division of the province into 2 parts, one to be run entirely by the Agricultural Department and the other to be run by the Industrial Department assisted in the matters of 'expert advice' by the Entomologist This will show which of the two Departments can spread sericulture more efficiently and quickly.

SECTION III.—EXPERIMENTAL FARMS.

Lyallpur.

9. *Area:* 614 acres.

Rainfall: June—September 1919, 7″·76.

„ October 1919—May 1920, 2″·13.

Mr. Roberts remained as Professor of Agriculture throughout the year. His report emphasises the results of the various tests, varietal, cultural, hydraulic and manurial, carried out at the Lyallpur Agricultural Station on wheat, cotton, sugarcane, barley, gram, toria and other crops.

Punjab-11 and 8-A.—Mr. Roberts' analysis of the yields of these 2 types of wheat on 102 plots, gives an average higher yield to Punjab-11 of 14 seers per acre. Assuming an average yield of 25 maunds per acre, and a co-efficient of variation of 30 per cent. which latter is roughly the common variation of wheat yields at Lyallpur, the probable error of the difference of yield would be about 28 seers. Thus the difference in favour of Punjab-11 cannot be regarded as decisive so far as the 1919-20 Lyallpur Farm results go. Whether a study of the yields of adjacent plots, which at the moment it is impossible for me to undertake, would confirm Mr. Roberts' conclusion it is idle to speculate on. The very remarkable yield of 43 maunds equivalent to nearly 57 bushels (at 62 lbs. per bushel) per acre obtained last season at Lyallpur is to be noted. This may be compared with the record yield obtained in Wye, Kent, by Mr. Alfred Amos, of 96 bushels per acre, with 'Yeoman,' one of Biffen's crosses. This was a winter wheat.

American cotton.—The deleterious effect of the dry climate prevailing in August and September 1919 is adverted upon by Mr. Roberts, but his view that the American cotton crop "on the whole did very well in the colonies" is hardly conformable with the conclusions reached by Mr. Milne after a very thorough enquiry throughout the Province

(*vide* Part II). From Mr. Milne's data my own estimate, given for what it was worth, was that the loss caused in the colonies from growing of 4-F. was 70,000 bales. This may be compared with Mr. Roberts' estimate of the total colony crop as over 200,000 bales.

Whatever quantitative views may be held, there can be no question, but that 4-F. did suffer very severely in the Lower Chenab and Lower Jhelum colonies last year, and we must not rest on our oars and assume that 4-F. is the last word in American cotton for the Punjab. 285 promises well as compared with 4-F., as its superior quality will probably more than compensate for a smaller yield, even if the latter is found to occur.

Sugarcane.—The yield of *gur* obtained from *suretha* cane (64 maunds) was 12 maunds in excess of the yield of *katha* canes. This agrees with the 1919-20 results at Lyallpur, where as much as 77½ maunds, or nearly 3 tons was obtained on one of the *suretha* plots. On irrigated lands in the Province the yield of *gur* averages less than 1 ton per acre, so that there is clearly scope for improvement.

Toria.—Mr. Faulkner continues his work on the selection of *toria* types. The reduction of yield produced by harrowing in square 26 is curious: though really from one such experiment nothing can be deduced with certainty.

Gurdaspur Agricultural Station.

10. *Area*: 161 acres.

Rainfall: June—September 1919, 24″·5.

,, October 1919—May 1920, 5″·9.

Sugarcane.—This is the chief kharif crop to the improvement of which the Farm is devoted. From statement 2-A the standard deviation of the yield of *gur* is about 330 lbs. so that to establish a difference of yield of 1 maund between two different varieties, on adjacent plots with a correlation of ·70 between each other, would require $\left(\frac{3\,8\,0}{2\,4\,1\,0}\right)^2$ duplicates. This is equal to 60. The comparative tests of statements 2-A and 2-B are, therefore, quite insufficient to prove any superiority of a specific type over any other.

The comparison of the percentage extraction of juice from various mills is interesting. I had tests carried out

in the presence of the Sugar Committee last December, which showed that the Nahan 3 roller mill was slightly more efficient in extraction than the Chattanooga power-crusher. The results given in statement 2-D confirm this result, with a more decisive advantage in favour of the Nahan mill. The rate of crushing of course is far greater in the power-mill, where it is 10 maunds of cane per hour, against 3 maunds crushed by the Nahan mill, with 2 strong bullocks. The Poona furnace for the Muscovada process was finished last winter and used for *gur* making. It is not stated what cane was used in the experiments, but the percentage of *gur* to juice, 15 per cent. is lower than any of the proportions, varying from 15·15 to 17·44 per cent. for the ordinary method of extraction, and the process as worked at Gurdaspur was apparently wasteful of *gur*, even if it was economical of fuel.

No. 202 is said to be the best Coimbatore cane.

Wheat.—The results of the varietal tests put 8-A as the best yielder on both the irrigated and *barani* land, with yields of 21 and 20 maunds of grain respectively. These yields compare poorly with the bumper crops obtained at Lyallpur last spring. Some of the crosses, which Mr. Milne, wittily describes as Ammonium Pusiates, have done well.

Manurial experiments.—The manurial experiments want a very detailed examination, and I am rather sceptical of the value of such experiments unless a chemical and moisture-content analysis of the soil is made before, during and after the growth of the crop. Away from a laboratory such determinations present difficulties.

Serai.—The *serai* for the visitors to the farm and for the Vernacular class, which is to be started this winter, is practically finished. A few articles of furniture will be necessary, for which I have agreed to find Rs. 2,000.

For the greater part of the year Maulvi Fateh-ud-Din was the Deputy Director in charge, and his experience enables him to run the circle well. M. Mukhtar Nabi is a good farm manager. Malik Sultan Ali, I.A.S., has been in charge since April, and has entered on his duties with a zest, which I trust will be maintained.

Hansi Agricultural Station.

11. *Area*: 200 acres.

Rainfall: June—September 1919, 7″·0.

„ October 1919—May 1920, 3″·3.

Cotton.—Sardar Darshan Singh claims that his Bhatla cotton yielded 11 maunds as against 5 maunds average for the Hissar District, and it also has the high ginning percentage of 40 per cent. While no doubt this cotton is a good one, it is scarcely fair to compare the yield of any cotton which receives the careful treatment of an experimental farm with the general average of a district. Rosea-74, Bhatla selection, is now used as a standard for varietal tests and 14 different varieties have been tried out against this standard. While in the initial stages a number of varieties, with a few experimental plots, are necessary in order to weed out hopelessly inferior types, yet, as selection advances, it is quite useless to test a variety of cotton except by using a large number of adjacent plots. Thus with Sardar Darshan Singh's Bhatla selection—(*vide* statement IV)—I found the mean yields to be 9·6 maunds with a standard deviation of 2·34 maunds. This gives a co-efficient variation of 24 per cent. and, if therefore, a type of cotton is being tested against this standard, at least 16 adjacent plots will be required if a difference of yield of one maund is to be significant, assuming a correlation of ·70 between the yield of adjacent plots. If the correlation of adjacent plots is zero, as many as 50 duplicate plots will be required. The kharif 1919 cotton was valued by Tatas who put Rosea-74 and White-flowered Neglectum (both Bhatla selections), at Rs. 31-4-0 per maund as against Rs. 46-4-0 per maund for 4-F. In order to facilitate ginning of cotton and securing a pure seed, Government has sanctioned the erection of an 8 H.P. engine with 2 roller gins on the Farm. This will be a great help in future years. In a test of broadcasting *versus* line sowings in 2 one-acre plots, the broadcasted cotton gave an increased yield of ·9 maunds over the cotton sown in lines. While the test is of course quite inconclusive, the result is somewhat strange.

Wheat.—Sardar Darshan Singh puts 8-A, 9-C, Punjab-11 and Pusa-12 in the order named as yielders using only the varietal tests on the experimental area, but if we include

the data from the tenants' area as well—(*vide* statements in part II) - I find the following results :—

Statement.	8-*A.*	9-*C.*	*Punjab*-11.	*Pusa*-12.
18 (I) ...	29·4	27·8	30·6	24·4
18 (II) ...	31·2	30·7	26·5	16·9
18-A ...	31·0	...	28·2	...
18-B ...	26·0	17·9	25·6	...
18-C ...	...	..	23·7	...
18-D ...	22·2	...	25 3	...
	5/139·8	3/76·4	6/159·9	2/41·3
	28 0	25·5	26·7	20·6

which put the order of the wheats: 8-A, Punjab-11, 9-C, and Pusa-12. The actual yields of Punjab-11 and 8-A on the tenants' area are identical at 26·4 maunds per acre. The results show, what has been emphasized elsewhere, that the conditions under which the wheats are grown have a great influence on the relative yields. For a proper test of 8-A and Punjab-11 to prove a one maund superiority of either, 24 duplicate plots should be used.

Sugarcane.—The yields as compared with 77 maunds at Lyallpur for *suretha* cane are low, the highest being that of mungo-cane with 50·6 and 41 maunds of *gur* per acre. But the yields at Gurdaspur are lower still. *Lahauru* comes next with 38 maunds. These canes received 15 tons of farmyard manure per acre, and it is noteworthy that including the application of the farmyard manure no less than 63 agricultural operations had to be given to the crop before it was ripe.

Fodders and grasses.—Very little success had been obtained with drought-resisting grasses although this was one of the objects for which the farm was started. I agree with Sardar Darshan Singh that a *serai* and a rest-house for visitors are badly needed. Both Sardar Darshan Singh and Maulvi Fateh-ud-Din, who has recently officiated on the Farm, consider the site unsuitable owing to inequality of the soil. It should be possible to reduce the inequalities in time though they may never be eliminated entirely. Sardar Darshan Singh takes great interest in his work, and he undoubtedly has a harder task than at any other experimental farm, in producing good crops.

Section IV.—District Work.

Seed and Demonstration Farms.

12. Possession of land for the demonstration farms was taken at Ludhiana and at Amritsar on 25th November 1919. The actual allotments out of the grant of one lakh from 'Wheat profits' for demonstration farms were :—

	Rs.
Buildings for the Jullundur Farm	18,000
Buildings for the Sialkot Farm	17,272
Shakargarh seed godown	7,735
Kala Afghanan seed godown ...	1,485
	44,492

Land is being acquired for a demonstration farm at Hoshiarpur, and I have promised to give Rs. 37,000 to the Deputy Commissioner this year. Rs. 17,100 for buildings at the Khalsa College farm will also be spent during the current financial year.

The levelling of the land for the Khalsa College farm has been proceeding apace owing to the energy of the Principal, Mr. Wathen.

A course for soldiers at Jullundur Cantonment, suggested by Major Woolley, 56th Sikhs, has been started at the Jullundur Demonstration farm, and the Director of Public Instruction has also asked me to draw up a course for school boys the practical teaching of which will be given on the Demonstration farms.

Great praise is due to the District Engineer of Ludhiana who has put up the best built farm buildings I have seen at any demonstration farm, at much below the usual rates.

In sharp contrast to these, the Chillianwala seed farm buildings were as badly built as they could be. I wrote to the Executive Engineer expressing my condemnation of them, and I have since been told by the Deputy Director of Agriculture that they were partially demolished in a gale of wind.

The Montgomery seed farm badly needs Agricultural Assistants and Mukaddams quarters, and it is hoped that Government will sanction the proposals recently sent up.

Seed Depôt accounts.—The Profit and Loss account from the sale of seed (wheat and cotton) is as follows :—

Profit and loss account of Wheat seed depôts in the Punjab for the year ending 31st March 1920.

Name of Depôt.	Quantity purchased.	Purchase money including other charges.	Sale money.	Profit or loss.	Remarks.
1	2	3	4	5	6
	Mds. sr. ch.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Hansi Depôt ...	734 6 0	4,682 2 6	4,569 1 0	313 1 6	Loss.
Lyallpur Depôt ...	5,296 3 0	31,043 6 4	30,897 1 6	146 4 10	Do.
Montgomery Depôt	4,300 0 0	25.017 6 9	25,146 11 0	129 4 3	Profit.
Gurdaspur Depôt ..	2,919 12 8	18,694 4 3	18,961 0 3	266 12 1	Do.
Total ...	13,249 24 8	79.637 3 9	79,573 13 9	63 6 0	Loss.

Profit and loss account of Cotton seed depôts in the Punjab for the year ending 31st March 1920.

Name of Depôt.	Quantity purchased.	Purchase money including other charges.	Sale money.	Profit or loss.	Remarks.
1	2	3	4	5	6
	Mds. sr. ch.	Rs. a. p.	Rs. a. p.	Rs. a. p.	
Hansi Depôt ...	2,085 24 14	12,288 2 9	12,092 12 2	195 6 7	Loss.
Lyallpur Depôt ...	13,258 0 0	68,767 1 0	1,96,728 3 3	1,27,961 2 3	Profit.
Montgomery Depôt	10,198 20 0	60,597 8 9	61,591 8 3	993 15 6	Profit—value of stock on hand on 31st March 1920 has been added to sale money.
Gurdaspur Depôt ...	9,717 0 0	85,935 15 3	91,365 13 2	5,429 13 11	Profit.
Total ...	35,259 4 14	2,27,588 11 9	3,61,778 4 10	1,34,189 9 1	Profit.

The allotments made this year were :—

	Rs.
Lyallpur (including Montgomery) ...	2,75,000
Gurdaspur (including Sargodha) ...	90,000
Hansi	30,000
Economic Botanist for Cotton	4,000
Deputy Director of Agriculture, Gudaspur for, purchase of lucerne seed from Australia ...	10,000
Purchase of date-suckers from Mesopotamia ...	10,000
	4,19,000

13. Sowings of Punjab-11 for the last 3 years are as follows :—

Wheat.

	1917-18. Acres.	1918-19. Acres.	1919-20. Acres.
Lower Chenab Canal .	100,000	150,000	220,000
Lower Jhelum Canal ..	45,000	50,000	55,000
Lower Bari Doab Canal ...	50,000	100,000	100,000
Upper Chenab Canal ...	1,500	2,500	2,500
TOTAL ...	196,500	3 2,500	377,500

In addition to the area under Punjab-11 in the Colonies there are reported to be 675 acres under 8-A, and 70 acres under Pusa-12 on the Lower and Upper Jhelum canals. In *barani* tracts Pusa-12 is a favoured wheat as it ripens a fortnight earlier than the Punjab types and requires less water. 8-A is apparently liked in the sub-humid tracts, and has not the disadvantage of shedding and beardlessness.

In the Hill States Pusa-12 is very popular, and Mr. Peake of Solon has done splendid work in introducing it in Keonthal, Baghal, Bâghat, Patiala, and Sirmoor. In the last-named State, according to Mr. Peake, Pusa-12 is likely to be the only wheat grown in a few years' time.

Last year I mentioned that Punjab-11 must be regarded as a better yielder than Pusa-12, with a probability of 15 to 1. I find, however, that scientific plant-and-cattle-breeders (*e.g.*, Wood and Stratton, Mitchell and Grindley) consider that a probability of 30 to 1 is desirable before regarding a superiority as established, and there must be a slight reservation put on my conclusion of last year. With reference to the relative merits of Punjab-11 and 8-A, the evidence is most conflicting, and wants most careful examin-

ation with reference to soil conditions, irrigation, climate, and manuring. Mr. Roberts finds Punjab-11 the better at Lyallpur and Montgomery (but see my remarks in paragraph 9), 8-A is reported to have a greater yield in three villages in Jullundur in a demonstration arranged by the Agricultural Assistant, and Sardar Darshan Singh says it has a higher yield than Punjab-11 in Hansi (but as noted in my comments on Deputy Director's report his conclusion is not clearly borne out by his own figures). In flour and *ata* quality, Pusa-12 and 8-A are probably slightly superior to Punjab-11.

Cotton.

14. The following are the most recent figures of cotton sowings, American and *desis*, in the Canal colonies :—

	Name of Canal.	Crop in 1919-20.			Crop in 1920-21.		
		American.	Desi.	Total.	American.	Desi.	Total.
Lower Bari Doab Canal.	Balloki Division ...	25,424	3,241	28,665	...	...	...
	Khanewal Division...	34,744	27,714	62,458	62,871	6,540	69,411
	Montgomery Division	51,295	1,015	52,310	78,346	6,975	85,321
	Okara Division ...	61,185	38,691	99,876	85,904	3,747	89,651
	Total ...	172,648	70,661	243,309	227,121	17,262	244,383
Upper Bari Doab Canal.	3rd and 4th Divisions	16,668	96,535	113,203	14,593	143,357	157,950
	Multan Canals .	12,989	48,758	61,747	12,214	50,193	62,442
	Upper Sutlej Inundation Canals.	11,859	27,101	38,960	11,160	8,784	19,944
	Total in Montgomery Circle	214,164	243,055	457,219	265,118	219,601	484,719
Lower Chenab Canal.	Upper Gugera Division,	49,341	12,790	62,131	...	...	65,056
	Barala Division ...	46,075	5,103	51,178	...	...	50,437
	Jhang Division ...	44,288	11,118	55,406	54,093	7,475	61,568
	Hafizabad Division .	2,833	5,611	8,444	...	...	11,300
	Lyallpur Division .	63,927	19,910	83,837	...	...	85,000
	Lower Gugera Division ...	20,229	43,526	63,755	Not yet	known.	
	Total ...	226,693	98,058	324,751	...	...	273,261

According to these figures the percentage of American cotton on the Upper and Lower Bari Doab canals rose from 47 in 1919 to 55 in 1920, while in 1919 the American cotton constituted 70 per cent. of the total cotton crop on the Lower Chenab. The 1920 figures for Jhang Division suggest that American cotton has not diminished in favour even in areas where it suffered last year. Zamindars, who had grown both American and *desi* crops last year side by side, and had seen the relatively smaller yield of the former, seemed to think it was just a chance occurrence, and that American was at bottom the better crop.

The effect of the heavy rainfall just before flowering time in August 1919, the simultaneous development of bolls, and the consequent great increase of the water requirements of the cotton plant, in September and October, coinciding with a cessation of rainfall, have been carefully studied by Mr. Milne and his assistants in Part II.

The rainfall map for September and October printed in Part II indicates that the area which received less than 1" of rainfall *and* below normal rainfall was not the area affected. The boundary of the effect of the draught in those two months corresponds closely with the line of 60 per cent. relative (8 A M.) humidity, running through Rawalpindi, between Lahore and Montgomery, and on through Ambala. The bulge of the humidity curve towards Montgomery is suggestive, because the Lower Bari Doab Colony hardly suffered at all, Major Vanrenen getting a good crop at Renala, and the Okara Oat Hay Farm, the highest yield per acre since 1914-15, namely, 7·92 maunds of *kapas* (including picking charges).

The two important problems raised by the fall in yield of American cotton last year in the Lower Chenab and Jhelum colonies are :—

(1) The supply of canal water in September and October.

(2) the question of the systematic deterioration of 4-F under Zamindari conditions, and the discovery of a drought-resisting American cotton.

Last year in the Canal colonies American cotton needed at least three waterings on the Lower Chenab Canal in September and October, giving at 3 inches per watering, a demand

of 13·1 million acre inches, against a supply of 1·7 million acre inches. The discharge of the Lower Chenab Canal at Chhinawan in these two months averaged 9,300 cusecs, giving in all 8·7 million acre inches thus :—

Cotton	...	...	1·7	million	acre inches.
Toria	...	...	0·8	„	„ „
Wheat	...	...	2·0	„	„ „
Maize	...	...	1·0	„	„ „
Rice	...	...	0·6	„	„ „
Others	...	...	2·3	„	„ „
	Total	...	8·7	„	„ „

These figures are based on the water requirements of crops as found at the canal experimental outlets.

As 8·7 million acre inches would be given by a discharge of roughly 6,000 cusecs it appears that nearly ⅓rd of the canal discharge at Chhinawan is lost by evaporation, seepage and wastage. To produce therefore the additional 1·4 million acre inches required by the 1919 cotton crop, another 1,500 cusecs discharge for the Lower Chenab Canal would have been necessary throughout September and October. To supply the total of 10,800 cusecs is just beyond the capacity of the Lower Chenab at the headworks.

According to Mr. Milne 285 is more drought-resistant than 4-F., and this is a matter of importance in view of the experience of the last two years, when the demand of cotton for water is exceeding the supply.

I do not propose to discuss the thorny question of possible deterioration of 4-F.

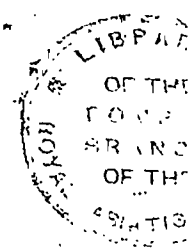
Mention should be made of the success of Punjab American cottons in Mesopotamia, where in yield 4-F. stood first with 34 maunds per acre, and 285 second with 32 maunds of seed cotton. These are enormous yields. On an average of plots in any one year at the Lyallpur Agricultural Station, American cottons have never given more than half these yields. In valuation in Baghdad Ashmouni cotton stood first, 285 second, and Webber 49 third in price per acre. 4-F. was sixth of the tested varieties. In India, Punjab American fetches a splendid premium, and

in the Bombay spot market was quoted higher than any other cotton on 20th August 1920. Fully-good Punjab American, quoted at Rs. 530 per candy against Rs. 510, for F. G. Dholleras, which was the next highest. F. G. Sind-Punjab was quoted at Rs. 213.

Cotton auctions.

15. Sixteen auctions were arranged for by the Agricultural Department, but those at Bhalwal and Sillanwali could not be held on account of rain. No auctions were held in the year under report by the Co-operative Department.

The amount of cotton sold was 53,512 maunds, and prices varied from Rs. 18-9-0 a maund at Kot Kapura on the 8th January 1920 to Rs. 23-1-0 a maund at Abohar on 4th January 1920. Details are given on the next page.



Cotton Auctions.

1	2	3		4		5		6		7		8		9	10
		Special Quality.		Quality A.		Quality B.		Quality C.		Quality D.		Quality E.			
Place.	Date.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Total sale.	Chief Buyers.
			Rs. A. P.		Rs. A. P.		Rs. A. P.		Rs. A. P.		Rs. A. P.		Rs. A. P.		
Montgomery ...	20th November 1919.	...	...	710	20 14 0	612	20 13 0	73	20 0 0	...	...	...	...	1,395	Messrs. Tata Sons & Co. Forbes, Forbes, Campbell & Co. Ralli Brothers. Japan Trading & Co. Hari Ram & Co. Khalsa Cotton Factory. Volkart Bros. Mathra Das Thakar Das. Jawinda Mal. Ganesh Cotton Factory (Sargodha). Diwan Chand (Lyallpur). Nur Bux (Kasur). Ram Bux-Daya Ram (Kasur).
Chichawatni ...	25th November 1919.	...	...	205	21 5 0	244	21 4 0	187	20 4 0	...	...	...	...	636	
Okara ...	29th November 1919.	...	...	329	20 4 0	447	20 4 0	...	...	...	...	...	...	776	
Gojra ...	12th December 1919.	...	...	252	21 13 0	...	...	...	...	...	...	...	...	252	
Lyallpur, I ...	18th December 1919.	236	20 12 0	...	...	...	...	...	...	...	...	...	...	236	
Jaranwala ..	3rd to 4th January 1920.	...	...	4,161	20 7 0	3,160	20 5 9	398	20 0 0	1,586	20 5 0	4,015	19 13 9	17,192	
Mian Channun ...	19th January 1920.	...	...	389	20 9 0	3,872 809	20 5 0 19 15 0	...	...	...	...	...	...	1,198	
Lyallpur, II ...	26th January 1920.	1,459	21 14 0	...	...	107	20 0 0	80	20 0 0	...	...	...	...	1,646	
Sargodha, I ...	17th December 1919.	...	...	1,174	21 3 0	3,506	22 10 0	602	20 0 0	...	...	...	...	5,282	
Bahauddin ...	20th December 1919.	...	...	1,363	20 8 0	975	20 0 0	539	19 9 0	...	...	...	...	2,877	
Phulerwan ...	5th January 1920	...	...	...	...	784	19 15 0	508	19 7 0	282	19 2 0	...	...	1,574	
Sargodha, II ...	21st January 1920.	...	...	1,844	21 0 0	1,134	20 9 0	269	19 15 0	...	...	...	...	3,247	
Abohar ...	4th December 1919.	1,044	23 1 0	2,748	22 4 0	1,453	21 6 0	350	21 6 0	330	20 4 0	...	...	5,925	
Kot Kapura ...	8th January 1920	4,174	19 6 0	3,934	19 0 0	1,660	18 15 0	1,107	19 2 0	398	18 9 0	...	...	11,273	
	Total ...	6,914	...	17,109	...	18,763	...	4,113	...	2,596	...	4,015	...	53,513	

The quantity auctioned is less than half of that auctioned last year. This is due to the failure of American cotton on a large area in the year under report. A mention of the causes has been made elsewhere. Full details are given in Part II.

Chari Seed.

16. The following statement shows the final account of the *chari* seed purchased in June 1919. The loss to Government is Rs. 24,910-10-5, which is almost exactly the sum (Rs. 25,000) that I anticipated in paragraph 18 of my annual report last year :—

Jowar Seed Account.

1	2	Disposal of Stock.				6	7	8	9
Name of Depot.	Quality originally consigned.	Quantity sold.	Rejected or Wasted.	Stock in hand on 31st August 1920.	Total Sale Price.	Spent by Tahsildar in charge of Seed from Sale Proceeds.	Net Sale Proceeds (6—7).	Expenditure incurred through Director of Agriculture.
	Mds. s.	Mds. s.	Mds. s.	Mds. s.	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Phillour ...	1,047 8	537 8	4 0 0	...	3,616 8 0	9 6 9	3,607 2 0	35,550 2 3
Jullundur ...	944 10	441 14½	472 35½	30 0	1,611 7 0	14 10 9	1,696 12 3	
Hoshiarpur	1,250 0	5,510 12	11 0	723 28	1,026 4 6	...	1,028 4 6	4 15 6
Hissar ...	1,750 0	1,650 0	100 0	...	4,714 4 7	...	4,714 4 7	...
Total ...	4,991 18	3,188 34½	1,043 35½	753 28	10,963 8 1	24 0 9	10,944 7 4	35,555 1 9

17. The statement below shows the sale of imported implements, as well as their prices during the last five years :—

Implements.

Name of Implement.	1915-16.		1916-17.		1917-18.		1918-19.		1919-20.		+ or — over last year.
	Price.	No. sold.	Price.	No. sold.	Price.	No. sold.	Price.	No. sold.	Price.	No. sold.	
	Rs. A. P.		Rs. A. P.		Rs. A. P.		Rs. A. S.		Rs. A. P.		
Raja plough	29 4 0	202	36 0 0	379	50 0 0	63	9 0 0	123	49 0 0	228	+105
Meston plough ...	8 12 0	906	9 10 0	1,264	9 10 0	557	9 10 0	158	16 8 0	76	-77
Other ploughs ...	62 0 0	79	65 0 0	92	65 0 0	41	65 0 0	9	95 0 0	4	-5
Raja reapers ...	300 0 0	...	352 0 0	...	440 0 0	...	440 0 0	...	440 0 0	8	+8
Hoes	32 0 0	13	46 8 0	10	68 0 0	10	58 0 0	13	58 0 0	8	-5
	46 0 0		53 0 0		75 0 0		65 0 0		85 0 0		
	39 0 0	55	65 0 0	56	65 0 0	30	65 0 0	12	82 0 0	54	+42
Harrows... ...	55 0 0		68 0 0		98 0 0		98 0 0		98 0 0		
	55 0 0	58	88 0 0	42	72 0 0	11	75 0 0	80	90 0 0	50	-30
Fodder-cutters ...	71 0 0		71 0 0		119 0 0		119 0 0		119 0 0		
Miscellaneous	...	10	...	20	...	13	...	6	...	4	-2
Total ...	..	1,323	...	1,963	...	725	...	396	...	432	+36

The prices in 1919-20 are in most cases double those of 1915-16, and it is no wonder that the number sold has fallen from 1,323 in 1915-16 to 432 in 1919-20. The main decreases as compared with the last year's figures, are under Meston ploughs and fodder-cutters, as the prices of these have gone up from Rs. 9-10-0 to Rs. 16-8-0 and from Rs. 75 to Rs. 90, respectively, in the course of one year. There is, however, an increase of 36 in the totals of this year over those of the last year.

The following implements, manufactured by the Department, were sold in addition :—

Name of Implement.	Lyallpur.		Gurdaspur.		Hansi.	
	1918-19.	1919-20.	1918-19.	1919-20.	1918-19.	1919-20.
Bar harrows	293	341	37	85	...	6
Drills	100	181	6	5	19	1
Lyallpur hoes	86	79	10	...	...	...
Miscellaneous	189	1,676	...	...	38	6
Total ...	668	2,277	53	90	57	13

This number is sure to increase very considerably when the new workshop is ready at Lyallpur.

1918-19 ... 778.
1919-20 .. 2,280.

Agricultural Associations.

18. An Agricultural Association has been formed at Rohtak. There are now eleven agricultural associations in the Province. They do a good deal of propaganda work, and the discussions at the meetings are of great help in the spread of methods of cultivation recommended by the Department and of modern implements and in the sowing of approved seed.

The estimate for the erection of the seed godown at Kala Afghanan for the Co-operative Credit Societies was raised from Rs. 936 to 1,485. The money has been placed at the disposal of the Agricultural Engineer, and the godown is in the course of erection.

SECTION V.—Other Activities.

The Lyallpur Elevator.

19. The elevator ran its trial trip on the 15th of May and was open to receive wheat from the public from the 14th of June 1920. Receipts and discharges of wheat up to 31st August have been as below :—

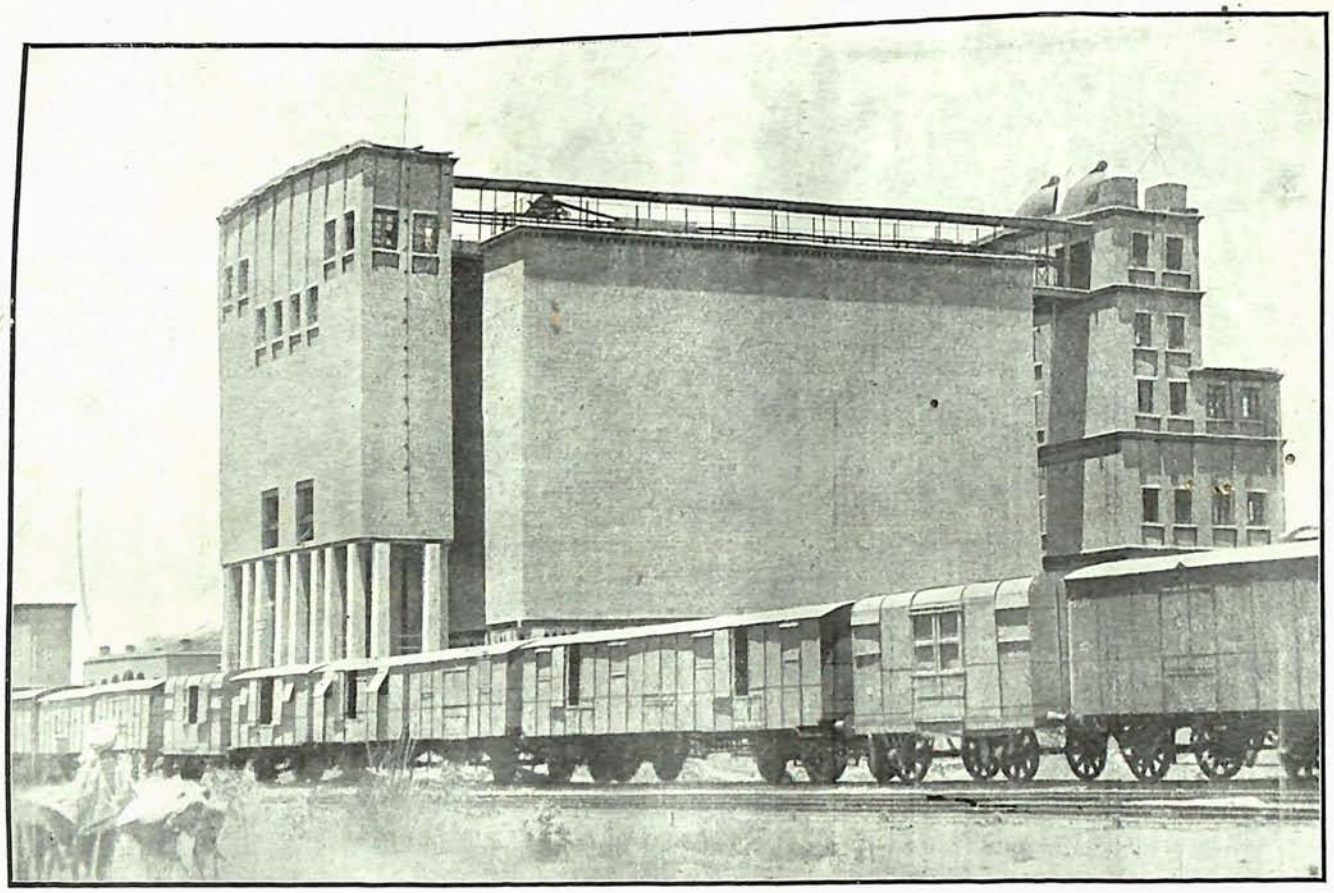
Date.	Intake.	Discharge.	Balance.
	Mds. s. c.	Mds. s. c.	Mds. s. c.
30th June 1920 ...	21,125 19 13	3,118 15 9	18,007 4 4
31st July 1920 ...	26,355 15 13	10,209 37 5	34,152 22 14
31st August 1920 ...	1,820 35 2	5,257 32 9	30,715 25 7
	49,301 30 12	18,586 5 5	30,715 25 7

Great difficulty has been experienced owing to leaking of the elevator roof, but now that malthoid strips have been laid down it is hoped that these difficulties will not recur.

The early erection of delivery elevators is imperative, as at present off-loading has to be done by hand from among a maze of pillars which makes this proceeding most laborious. It was decidedly a false economy to reduce the efficiency of the elevator by half, in order to save some 20,000 rupees odd out of a total expenditure of nearly 5 lakhs.

Two photographs of the elevator are attached to this report.

As I anticipated the business details involved in running the elevator have been enormous, and could never have been carried out except by a business organisation like that of Messrs. Clements Robson. Mr. Owen Roberts is a man of very long-sighted views, and this faculty as well as business experience is required to make the elevator system a success. A more detailed report will be sent up separately.



Lyallpur Elevator on the "delivery" Side.

Lyallpur Elevator. Wheat being dumped at the Intake boot 15th May 1920.

Manures.

20. Attention is drawn to the interesting analysis made by Mr. Faulkner of the manurial experiments which were designed by the late Mr. Barnes, and have been in progress at Lyallpur since 1911. Unfortunately, owing to an error in the rotation and to the failure of the maize crop in 1914, 1916 and 1917 in certain plots, the value of the experiments has been much diminished. However the main conclusion drawn by Mr. Faulkner as to the value of nitrogenous manures, *e.g.*, Calcium Cyanamide, Calcium Nitrate, and Ammonium Sulphate, appears to be fairly conclusive.

Poultry and Olives.

21. The Poultry Show held last year at the Barnes Court was an unqualified success, and I was much struck with the excellent type of birds exhibited. The total expenditure was Rs. 214 against an income of Rs. 226-12-0, Rs. 200 out of which were contributed by the Punjab Government as a grant-in-aid. I have asked the Secretary to carry forward the balance to the credit of the next Simla Poultry Show.

No extension of the Khairimurti olive plantation was made during the year.

Experiments to extract olive oil were made by the Forest Economist at Dehra Dun, and he has reported as follows :—

"The Indian olive oil promises to be as good as the European oil, and, in view of the present scarcity and high prices of the latter, the Punjab experiments appear to be of considerable economic value."

As a suitable hydraulic press was not available at Dehra Dun when the fruit reached there, the Deputy Conservator of Forests, Rawalpindi, West Division, is again sending a maund each of selected and average olives for expression at Dehra Dun.

Colony Grants.

22. The following lands have been allotted in the Lower Bari Doab Canal Colony for agricultural purposes :—

(1) Fruit Farming.

The seven rectangles ear-marked for Mr. Ganda Singh Cheema for fruit farming await his return from America. He studied horticulture at Covent Garden in England for a short

time and then proceeded to Washington D. C. He has now been directed to take a year's systematic course at Maine University.

(2) Dairy-farming.

Bhai Datar Singh, for whom an area of 20 rectangles had been ear-marked, has completed a year's course at Kingston, Derby, and has arrived in India.

(3) Marmalade-making.

A grant of 135 acres, 3 kanals and 10 marlas was ear-marked for Colonel Wikeley for marmalade-making, but we have not yet come to an agreement as to the conditions of the grant. Colonel Wikely has not yet replied to my letter of 12th March last.

(4) Fruit-tree Plantation.

A tenancy of 722 acres, 3 kanals and 19 marlas has been recommended for Mr. F. J. Mitchell for fruit-tree plantation. The object is to grow good varieties of grapes, raisins, oranges, etc., on a commercial scale. The tenant is to keep an expert in fruit-culture approved by the Director of Agriculture.

(5) Grant for Cotton-growing.

The British Cotton-growing Association re-opened the question of the grant of 7,500 acres of land near Khanewal, and a final draft of conditions on which the Government is prepared to lease the land has been sent to the Secretary of the Association. Mr. Roberts is leaving the Department in order to act as Manager for the British Cotton-growing Association.

Besides the above 1,623 acres near Kala Shah Kaku are being leased to S. Gurdit Singh, who successfully started a tube well of his own at Shamgarh, in the Karnal District, for experiments in tube-well irrigation.

Provincial Board of Agriculture.

23. In pursuance of a resolution passed at the last meeting of the Pusa Board of Agriculture, a Provincial Board of Agriculture has been formed for the Punjab under the presidency of the Financial Commissioner. Its first meeting was held at Lyallpur on the 9th of January 1920, and some important questions were discussed.

Gazetted Officers' Estate.

24. The Gazetted Officers' Estate in Lahore produced 540 maunds of wheat and 65 maunds of rice, the net receipts being Rs. 3,672-1-0 against an expenditure of Rs. 6,776-13-0.

SECTION VI.—General.

Aeroplane Photography.

25. No doubt there is an appearance of meretricious advertisement about this work which had led to my proposals for the development of it to be turned down after I had secured a promise of a gift of six aeroplanes from the Government of India. Nevertheless further experiments were unanimously approved by the Pusa Board of Agriculture in December last, and the authoritative scientific journal *Nature* has referred to my preliminary work last year in an article entitled "Aircraft Photography in the Service of Science." The remarks read:—"Botany.—The student of vegetation who may be sufficiently fortunate to obtain aerial photographs of the ground is at once in possession of the basis of an ideal vegetation map. Different types of vegetation show up very clearly, and also, of course, the transition from desert to open and closed plant associations (see figure 2). It is naturally necessary to go over the ground with photographs, but after a short time the characteristic tones and appearance of different vegetation types can be easily picked out. Even among crops it is possible to distinguish barley, wheat, and maize besides other plants, the cottons which have a distinct habit and growth period. Practical use of these facts was made in Mesopotamia for ascertaining the acreage under wheat cultivation, and trials have been made in India with the view of carrying out crop surveys by aeroplane photography.

I have not had the opportunity of making many observations on the subject, but it may be of interest to mention a small point observed in connection with the distribution of the willow and tamarisk scrub of the Jordan valley. This vegetation is limited by the water supply from the river, and succeeds in following the stream right down to the Dead Sea. Here, at the mouth of the Jordan, although surrounded by salt lagoons, a narrow belt of vegetation manages to survive as a fringe to the river with its rapidly-flowing stream of fresh water."

In science "ce n'est que le superflu qui soit nécessaire."

Forecasts.

26. The subject of crop forecasts was discussed at the last Board of Agriculture at Pusa, and I then stated that I doubted whether experts could in general estimate the outturn of fields with

an accuracy of 10 per cent. or less. Mr. Roberts took up the challenge, and, although my statement was meant to apply to estimates of fields of zamindars, a test of accuracy of estimation was made at the Lyallpur Agricultural Station on 15th April 1920, when the wheat crop there was dead ripe, and the yields of 32 different fields sown to Punjab-11 and 8-A were estimated independently by Mr. Roberts, Mr. Faulkner, and myself. The fields were subsequently reaped and the grain weighed, and the following errors of estimation were found:—

Observer.	*Mean Error in Estimate of Yield.*	*Number of Fields in which the Estimated Error was less than* 10 *per cent.*
W. R.	... 38 per cent.	3
O. T. F.	... 28 „ „	1
S. M. J.	... 27 „ „	8

Conditions favoured accurate estimates, as the past yields of the various plots were known, as also the manurial and other treatment and the number of waterings. The outturns in most fields were estimated at too low a figure. These tests confirm those made last year at Gurdaspur, under much severer conditions, where even larger errors were made, and emphasize that our present forecasts of yields are practically useless.

Experimental Error.

27. The work of Mr. Faulkner and myself has been continued, and it is hoped that some of the conclusions will be published shortly.

Reflections.

28. As I am shortly to leave the Department after officiating for two years, and having begun to get a glimmering of its problems and difficulties, I may be pardoned for referring to some of them.

(1) The Agricultural Department is, *par excellence*, a Research Department, and the greatest disaster that could overtake it would be for the energies of its officers to be sapped and their enthusiasm for research stunted by the growth of administrative work. There are already signs of this, and I can only say that I hope the day is not far distant on which, as a high Government official put it, "the time of the expert officers will be fully occupied."

(2) The budget allotment and actual expenditure on purely agricultural objects in the last ten years is as follows :—

(In lakhs of rupees.)

Year.	*Budget.*	*Actual Expenditure.*	*Savings.*
1910-11 ...	3·4	3·1	0·3
1911-12 ...	3·9	3·6	0·3
1912-13 ...	6·6	4·1	2·5
1913-14 ...	8·7	4·3	4·4
1914-15 ...	4·4	5·1	—0·4
1915-16 ...	6·8	6·0	0·8
1916-17 ...	5·8	6·5	—0·7
1917-18 ...	17·6	7·9	9·7
1918-19 ...	12·3	10·8	1·5
1919-20 ...	21·3	14·0	7·3
		Total savings ...	25·7

Thus it will be seen that—

While the variations of the budget allotment are indicative of fits of generosity towards agricultural development alternating with years of severe retrenchment, actual expenditure has been increasing serenely indifferent to the budget. This is as high a testimony to the efficiency of the Agricultural officers as could well be offered, as it is certain that had they attempted to spend all the money, which was thrown at Agriculture in 1913-14, 1917-18 and 1919-20 and as hastily withdrawn in the subsequent year, they could easily have done so. But a scientific department cannot rightly advance by fits and starts, and it is very necessary if progress is to be maintained that the proposed expenditure on Agriculture should be intimated to the Department for a

period of five years ahead, the sum being progressively larger as follows:—

	Proposed Budget.
1919-20	14 lakhs
1920-21	19 „
1921-22	25 „
1922-23	32 „
1923-24	40 „
1924-25	49 „

Though the budgets may look formidable I believe they are no more than will ultimately be considered reasonable, and the point is that Government will be much more likely to get its money's worth, and secure careful consideration of the relative merits of the various competing schemes if it makes the definite allotments quinquennially instead of annually as heretofore. The system of watertight allotments for each main head, evolved to suit the administrative conditions of thirty years ago, is too wholly unsuited to a scientific department.

It would savour too much of controversy to point out other ways in which the administration of Agriculture should be radically altered if the best results are to be obtained. But, perhaps, I may be permitted to point out in this connection that there would not be a man alive to-day if the phagocytes were to attack invading organisms, or the body cells were to proliferate, only after the central nervous system had given its grudging assent to their doing so.

The following are some of the pressing questions of Punjab agriculture, which should and can be answered with greater accuracy than is possible to-day :—

(*a*) The yield of wheat in the Punjab in 1920 may have been 4 million or 5 million tons, or some other figure. How are we to find out with a nearer approach to accuracy what the yields of the wheat crop are ?

(*b*) There has been a decrease of over 1½ million head of agricultural cattle in the Punjab in the last six years. What are the causes of this decrease, economic or physiological ? In par-

ticular what are the secular, seasonal and ephemeral changes of the birth and death-rate of cattle ?

(*c*) Is the quality of Punjab cattle improving or not ?

(*d*) American cotton failed throughout a very considerable portion of the canal colonies last year. The evidence of the Lyallpur Agricultural Station records, when statistically examined, does not prove that 4-F is a better yielder (in fact, it seems a bit worse, though it is of better quality) than some *desis*. There is an ever-growing list of apparently conflicting evidence of the relative yields of Punjab-11, Pusa-12, Punjab-8-A wheats. How is this evidence to be interpreted ?

(*e*) Many hundreds of varietal, manurial, hydraulic, and environmental tests of various crops are made each year at the experimental farms, a great proportion of which are worthless for comparative purposes. What criteria should be adopted for obtaining significant results ?

(*f*) In the next few decades there is likely to be an increase in intensive farming, and at the same time the introduction of mechanical cultivation. Both events will mean a greatly increased demand for artificial manures. Only very systematic tests will enable the Department confidently to recommend the proper manures. What form should these tests take in all the experimental farms ?

(*g*) Lyallpur has done splendid work for the Canal Colonies. The problems of dry-farming are in many ways different from those of irrigated cultivation. A dry-farming Institute is required at Ambala or Jullundur.

Officers.

29. Mr. Roberts will shortly be leaving the Department to take up the Khanewal cotton-growing grant for the British Cotton-growing Association after eleven years' work at Lyallpur. These years have witnessed the very rapid introduction of acclimatised

American cotton, till now 4-F is estimated to cover nearly 500,000 acres in the Punjab out of a crop of about 2 million acres. This is a very remarkable development, for which the great credit due is to be shared by Mr. Roberts and Mr. Milne. The Punjab cultivator is a shrewd person, and he would not have adopted 4-F cotton had it not in fact given him a bigger return for his money than the local varieties. Whatever the future of 4-F may be the solid achievement of the past cannot be ignored. The introduction and organisation of cotton auctions by which Punjab American cotton was able to secure its proper premium is another tribute to Mr. Roberts' sound business acumen. The introduction of sowing cotton in lines also constitutes a noteworthy progress. In securing the distribution of pure wheat seed a great work has been done, as uniformity is one of the chief desiderata of the buyer. In adopting the common type, Punjab-11, as the standard colony wheat, Mr. Roberts has again shown a wise caution, and though, in my opinion, his own data do not prove its superiority to 8-A, Punjab-11 is evidently a very useful wheat for a variety of conditions.

As Principal of the Lyallpur Agricultural College Mr. Roberts has shown qualities of a high order, as the prosperity of the College testifies. In every way Mr. Roberts has acted as the fly-wheel of the Department, a steadying influence on the enthusiasms, occasionally misguided, of those both below and above. His departure from the Agricultural service will be a very great loss to the Department.

Mr. Milne has continued his work with unabated enthusiasm, and the thoroughness with which he has completed a second series of milling and baking tests, after completing one laborious series at Delhi, is a proof of his desire to be satisfied with nothing less than a complete investigation of all the factors that go to constitute a satisfactory wheat.

Mr. Faulkner is a scientific agriculturist of the best type. He has taken a keen interest in the proposal for an Irrigation Experimental Station, and I know no man more likely to make a success of it.

Mr. Miller-Brownlie's department has been hampered for want of materials and facilities for manufacturing implements. Now that the Engineering workshop is well on

its way to completion it may be anticipated that Mr. Miller-Brownlie's inventive skill will have even greater practical results than before.

Lala Jai Chand has continued to be the mainstay of botanical teaching in the College, and continues to act as Superintendent of the Boarding-house. He is now officiating as Economic Botanist in place of Mr. Milne.

Of the Extra Assistant Directors, S. Charan Singh and Chaudhri Muhammad Abdulla deserve special notice ; while of the Agricultural Assistants, M. Muhammad Hassan and Chaudhri Ali Muhammad merit particular mention for their excellent work on the failure of 4-F cotton in 1919.

Of the gentlemen outside the Department I would like specially to thank Mr. Eastgate, Rai Bahadur Bhai Hotu Singh, and Mr. Jesson.

S. M. JACOB,

Director of Agriculture, Punjab.

APPENDIX I.

I HELD charge of the office of Principal throughout the year. Mr. Faulkner has been kindly doing most of the heavy routine office work since February.

The main points of interest are as follows :—

(1) Of 29 F. Sc. students who appeared in the University Examination 27 were declared successful and one was placed in the First Class.

(2) Twelve students appeared in the Final subsidiary subjects which are taken at the end of the third year, ten were declared successful.

(3) Out of the six Chief College men on the Rolls one has completed his leaving certificate, four are studying in the Degree Courses, and one has gone to England for further study.

(4) It is confidently hoped that some of the additional staff referred to in paragraph 5 of last year's report will be forthcoming shortly. The proposals for extension of the Chemical Section have been sanctioned and building should commence shortly. As regards the rest of the extensions the matter is still under discussion. It is very important that this extension should be well-balanced and be based on the needs of the College as a whole.

(5) Work with the Teachers' Class continues successfully. We are now dealing with the third batch of 20 students. The men sent this year are thought to be fully equal to the first lot sent.

(6) There were 268 applications for admission. It was very noticeable that the standard of applicants has gone up and very few third-class men presented themselves, 54 men were admitted including three from Sindh and of these 35 had passed the Entrance in the First Division.

We are now very short of accommodation in the hostel, and special arrangements have to be made for the Vernacular Class. It is hoped that the new hostel will be sanctioned early to enable us to cope with next year's demands, otherwise admissions must be seriously curtailed. The hostel was asked for in October 1918.

Vernacular Class.—There were 68 applicants and 47 admissions of whom nine were from the Co-operative Credit Society Department. Similar classes have not yet been started at Gurdaspur and Hansi. This work should be regarded as of first-class importance and urgency in those circles.

Rural Economy Class.—The following attended this Class for a month last March :—

Assistant Commissioners	2
Revenue Assistants	2
Zilladars Deputy Collector }	10
Co-operative Credit Societies Inspectors ...	4

One man from Ralli Brothers also attended.

Examinations.—

Class.	Number of students examined.	Number of students passed.	Number who obtained I Class.
Diploma	20	17	3
III-Year	12	11	...
Leaving Certificate Class	18	15	...
II-Year University Class	29	27	1
I-Year	51	46	3
Vernacular Class	28	28	...
Teachers' Class	21	21	...

Scholarships—Internal scholarships have been enhanced from two scholarships of Rs. 5 and 3, respectively, to five scholarships of Rs. 10 per mensem. The proposals referred to in last year's report for increasing the number of internal scholarships have been deferred for lack of funds. It is a matter of some importance for the welfare of the College and should be dealt with at an early date.

Applications for Admission.—The following table shows the number of applications for admission from each Division as well as from Native States and other Provinces.

Divisions.	*Number of Applications.*
Ambala	28
Jullundur	57
Lahore	65
Multan	66
Rawalpindi	30
North-West Frontier Province ...	2
Sind	4
Baluchistan	1
Native States and other Provinces ...	15
Total	268

The following District Boards have awarded scholarships :—

Dera Ghazi Khan ...	... One of Rs. 15 per mensem.
Jullundur ...	... „ „ 10 „ „
Jhang	... Two of Rs. 8 „ „
Hissar	... One of Rs. 12 „ „
Shahpur... ...	„ „ 25 „ „ „ „ 20 „ „ „ „ 10 „ „ for 6 months.
Gurdaspur ...	... „ „ 10 per mensem.
Kangra	... „ „ 6 „ „ plus fees.
Multan	... „ „ 15 „ „
Rohtak	Two of Rs. 10 „ „ each. Three of Rs. 10 „ „ each for 6 months.
Hoshiarpur ...	... One of Rs. 12 per mensem for 5 months.
Lyallpur ...	One of Rs. 15 per mensem from 13th October 1919. Two of Rs. 10 per mensem each for 6 months.
Amritsar ...	One of Rs. 10 per mensem from 14th October 1919. One of Rs. 10 per mensem from 11th December 1919. One of Rs. 10 per mensem for 6 months.
Karnal ...	... One of Rs. 10 per mensem for 6 months.
Muzaffargarh	Ditto ditto

Endowments.	*Yearly.* Rs.	A.	P
Kashmir State	960	0	0
North-West Frontier Province ...	480	0	0
Patiala	240	0	0

Endowments.	*Yearly.*		
	Rs.	A.	P.
Bombay	1,800	0	0
Kapurthala	147	0	0
Faridkote	360	0	0
Delhi	80	0	0
Baluchistan	417	11	10
Registrar, Co-operative Societies ...	480	0	0
Total	4,964	11	10

My hearty thanks are due to these District Boards and other donors for their generous help to the students of this College.

Hostel Clubs, etc.—The general health of students has been satisfactory. Difficulty is still being felt regarding medical attendance. A dispensary and part-time Sub-Assistant Surgeon will, it is hoped, be shortly available for the estate.

Manual Labour.—A system of paying students for extra manual labour was introduced over two years ago. This enables students who are badly off to earn some money every month, and it gives the Principal a very correct idea as to who is really in need of support and worthy of it. The number who took part in this for last year is 48 students, and some of these earned up to Rs. 22 per mensem.

Attendance.—Great difficulty has been experienced in checking students going on leave. It would appear that telegrams and requests for leave from parents can be had with great ease. Proposals for dealing with this have been sent up, but we are still awaiting orders on the subject.

Examinations.—Proposals regarding rules for promotion from one year to another have been put up. There has been laxity in this respect in the past and very little by way of clear guidance in the rules. The efficiency of the College demands that the standard throughout should be jealously guarded both in the interest of the future success of the Institution and in justice to past students, especially those who passed out from 1912 to 1914 when the standard was very severe.

On the whole, the prospects of the College are very bright, and it is gaining in popularity and reputation steadily. The future demands concentration and strengthening of the staff as main lines of policy, if its proper function as the centre for improving Punjab Agriculture is to be firmly and solidly secured.

W. ROBERTS,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

Report of the Professor of Agriculture, Lyallpur, on District work for the year ending 30th June 1920.

THE main results of the year are as follows :—

(1) Confirmation of the value of line sowing and interculture for cotton.

It is impossible now to get an exact estimate of the area sown in lines. Agricultural Assistants constantly come across new villages gradually adopting the practice. The large estates on the Lower Bari Doab have on the whole been very useful pioneers in this work. It is estimated that in the Lower Chenab Canal and Montgomery over 30,000 acres is now sown in lines. Very encouraging reports come in regarding frequency of interculture which is said to range from 3 to 7 times per crop.

(2) The local crop of American suffered severely owing to dryness of the season after mid August. Desi cotton gave better yields under these conditions which are however of rare occurrence. No. 285 which in habit somewhat resembles desi gave distinctly higher yield than 4-F., which is contrary to our previous experience. Extensive trials are in process of being conducted to get more reliable data on this point. The prospects of a good staple like 285-F. are extremely good if present premium continues.

The difference between Punjab desi and Punjab American in Bombay, now, is practically Rs. 300 a kandy. In fact, if American fetches Rs. 20 per maund of kappas next season desi should fetch Rs. 8 only—a very remarkable difference. This will of course not hold if the margin narrows down in the meantime. Over 150 acres of No. 285 is being grown with selected zamindars this year.

(3) Mollisoni retains lead among desi cottons.

(4) No. 11 has given a distinctly higer yield than 8-A as the result of 204 plot tests in various classes of land under various conditions. This confirms last year's results but is contrary to indications of previous three years, when tests were on a small scale. Wheat yields throughout have reached a record figure, being nearly 43 maunds per acre in some plots and thus 10 maunds per acre above any previous record on the farm.

(5) *Watering of cotton in May, June and early July.*—Indications again point to one or at most 2 waterings before mid-July being ample. Much water is often wasted in this period at present while more economical use might lead to great future development in expansion of canal areas.

(6) The beneficial effect of harrowing with the Bar Harrow in wheat and cotton is confirmed and the popularity of this implement is increasing steadily.

Implements.—Reapers.—The high price of labour attracted buyers this year and 8 were sold and several old once changed hands. It is expected that a demand will revive now even with the enhanced price of Rs. 440 per reaper.

Country implements.—The Bar Harrow designed and made at Lyallpur is increasing in popularity. The number sold during the year was 341 and there were over 50 orders in hand at end of June. There are over a thousand of these implements in use now in the colonies and some of them report having covered 200 acres; the average coming to nearly 100 acres each, which is very satisfactory. In my opinion the concession given as regards sale price ought to be continued until the Department has thoroughly worked out the minimum cost at which these can be made.

Of other implements, the most successful are 'kharif' and 'rabi' drills and the 'Lyallpur' Hoe. Chaff cutters which now cost Rs. 119 each are also very popular and some villages possess large numbers. Fifty machines which arrived last February were sold by Volkart Brothers within a week.

I think it is important to concentrate on the manufacture of simple implements as it represents very useful and important line of development with a very great future before it. Proposals will shortly be put forward for strengthening the staff engaged in this work.

Cotton in lines.—Heavy demands were made as usual for assistance in demonstration of line sowing and the practice has become a very live one. Constant care and study is however essential if progress is to be maintained. The area sown in lines is now estimated to be at least 30,000 acres in the Lower Chenab Canal and Lower Bari Doab Canal.

Cotton work.—The American cotton crop is reckoned to have reached an area of over 5 lakhs of acres. Reports this year indicate that this figure has been maintained in the present season. The American cotton referred to last year as being grown on the Sirhind gave very good results and was as good as any grown in the other colonies. Assistance was given from Lyallpur in running the sales and disposing of the crop which reached 2,000 bales.

As pointed out elsewhere the American crop suffered severely in places, and everywhere to some extent from the excessive dryness of late August, September and October. Inspite of this, many zamindars and large estates got a higher average yield than ever before, so that, had season been favourable a very heavy crop would have been obtained. No. 285 stood the climatic conditions better than 4-F and is being tried on a fairly large scale this year altogether 150 acres.

Cotton auctions.—As buyers have now had time to organize agencies there is less demand for auctions. During the year only auctions in new places such as Abohar and Kot Kapura could be termed very successful. The quantities received at Lyallpur and Montgomery were comparatively small though prices realized were good. A very

successful auction was held at Jaranwala where 17,000 maunds of kappas was brought. The matter has been discussed at meetings of the Agricultural Association and latter have pressed the department to continue holding a few auctions at least so as to stabilize prices. They were requested to give all the assistance they could, as, unless we get their co-operation our efforts are largely wasted. In the coming year it is proposed to hold two auctions only in each of the two canal colonies in this circle.

The Co-operative Department started an Arat shop at Lyallpur and attempted to conduct fortnightly auction sales. These for various reasons did not prove successful, though one would expect the demand for such an agency to strengthen in the future.

In the Lower Bari Doab Colony some zamindars co-operated in leasing a factory as in the past year and are, I understand, doing well.

Cotton seed.—We had to rely for good seed this year on parts of the Lower Bari Doab Canal tract especially Khanewal and Okara. A total of 22,000 maunds was sold at prices generally Rs. 2 above market rates. There was a very keen demand for seed and the efforts of the Department in securing reliable seed was much appreciated. The Railway Strike interfered with the work in the latter part of the period otherwise not one maund would have been left in our hands. The price charged at Lyallpur was Rs. 6-4-0 per maund, the market rate being generally about Rs. 4 per maund.

Wheat seed farms.—No. 11 wheat continues to hold a pre-eminent position and has shown itself superior to 8-A in the extended trials carried out this year. On the whole zamindars who have tried both are strongly in favour of No. 11 but much reliance cannot be given to this opinion as proper tests and weighments are never made. Both at Lyallpur and Montgomery where weighments were made the results are very clearly in favour of No. 11, see statements 1 and 2.

The distribution of wheat seed is very difficult as compared to cotton. The bulk required per acre, *viz.*, 24 seers and the large area sown by each zamindar renders expenditure for purchase of seed heavy if whole crop is to be grown with pure seed at once. With cotton on the other hand the zamindar never hesitates in buying the whole of his seed which at most costs him Re. 0-6-0 to Re. 0-10-0 per acre or say Rs. 2 per square, where 4 acres of cotton is grown. For wheat 11 acres on such a square would require 6 maunds of seed at a cost of Rs. 36 or more, besides cost of carriage. Inspite of this a total of 18,000 maunds were distributed at a premium of Re. 0-4-0 above market rates. The total area of pure No. 11 is estimated to be 3 lakhs of acres in the two colonies.

Montgomery Seed Farm.—A few interesting tests were made at this centre and deserve a brief discussion.

Watering experiments with 4-F cotton.—See statement V. Results indicate watering essential between May and July but there is little difference between 2 and 3 waterings as at Lyallpur.

Sowing cotton on different dates.—The later sowings, *viz.*, 20th May, have done best in the last season which was somewhat abnormal. There is every indication, however, that sowings can be much later on the Lower Bari Doab Canal than at Lyallpur without depressing the yield. This if borne out later is a significant fact as affecting the proposed Satlej Valley Project. (Statement 3) early and late toria results confirm those at Lyallpur (Statement 4 .

Comparison of No. 11 and 8-A, Statement II—See also statements I and VI regarding Lyallpur work.

Narwila Reh Farm.—There appears to be a decrease of 7 kanals in the area showing distinct signs of kallar and this decrease is confined to plots frequently watered last winter. Wheat yields averaged 19½ maunds --a figure which was only exceeded in 1916. Cotton suffered as in other places and gave an average yield of 3½ maunds only The water supply will shortly be on same basis as before the experiment started. The Department should keep in touch with the farm for some years to come.

Grain Elevator.—The Elevator was working in June and has so far received 47,500 maunds. The plant is being run by Messrs. Clement Robson and Co. and the Agricultural Section is keeping in touch with the work but has no direct concern with it.

Propaganda work.—The number of visitors continue to increase and a very keen interest in the work is manifested by the public. Scarcely a day passes without a number of people coming to see implements, buy seed and see crops and methods.

I have been assisted in the work by Mr. Faulkner since his return from leave in November. He has been responsible for a part of the teaching and experimental work and assists occasionally with district work. He is therefore in an excellent position to take over the whole work on my departure. Chaudhri Muhammad Abdullah, B. Labh Singh, and B. Charan Singh have done excellent work during the year. I may mention also B. Kartar Singh, Chaudhri Anant Ram and B. Jaimal Singh as being promising assistants. The section suffered by the loss of Lala Ram Nath, Agricultural Assistant, who died of pneumonia last March. He was a promising assistant. Assistance in district work and with Agricultural Associations has been obtained especially from Mr. Beazley, Colonization Officer, Montgomery, Mr. Puckle, Colonisation Officer, Montgomery, Malik Muhammad Hyat, Deputy Commissioner, Montgomery, Mr. Cannel, Superintending Engineer, Montgomery, Mr. Loughran, Superintending Engineer Lyallpur, Mr. Dobson, Deputy Commissioner, Lyallpur, and many others.

As this is my last Annual Report for Lyallpur I may be permitted to refer briefly to the main results of the work here since I came in 1909.

Cotton.—There were only a few hundred acres of American cotton grown in 1909 and even in 1911 including the comparatively large area

in Jhang the total area was well under 10,000 acres. It is now over 5 lakhs and safely established. None of this cotton was sown in lines and intercultured, whereas the area thus sown this year is estimated at 30,000 acres and should increase rapidly in future.

Wheat.—No pure area of No. 11 wheat could be seen in the early days, whereas now the general quality of the wheat of the whole Lyallpur and Montgomery tracts has been improved, and it is estimated that 3 lakhs of acres is grown pure. All firms agree in their testimony as to general improvement in quality and freedom from barley.

Implements.—The Bar Harrow and Kharif Drills have been evolved and are steadily growing in popularity and should ultimately have very important effect on the agriculture of the colonies. Our methods are being taken up by a daily expanding circle of zamindars and the future holds very healthy prospects provided efforts are not relaxed. The Marker and Lyallpur Hoe evolved by Chaudhri Muhammad Abdullah and Mr. Faulkner respectively are also steadily gaining in popularity.

W. ROBERTS,

Professor of Agriculture, Punjab, Lyallpur.

STATEMENT No. I.

STATEMENT SHOWING RESULTS OF WHEAT PUNJAB TYPE 8-A GIVEN OUT TO ZAMINDARS FOR TRIAL, RABI 1919-20.

STATEMENT

STATEMENT SHOWING RESULTS OF WHEAT PUNJAB

Serial No.	Grower's name.	Area.		Total out-turn		Yield per acre.		Dates of sowing.	Dates of harvesting.	Kind of soil and manure, if any.
		Kanals.	Marlas.	Maunds.	Seers.	Maunds.	Seers.			
1	S. Sant Singh of 207, B. B.	A. K. 5 3	14	118	16	21	27	16th November 1919. 15th November 1919. 14th November 1919.	26th April 1920. 27th April 1920 and 28th April 1920.	Residues of previous year. Maira land.
2	Lala Bhawani Das of 124, J. B.	A. K. 16 5	10	175	5	10	4	One killa on 12th November 1919. 3 killas on 9th and 10th December 1919. 6 killas between 15th and 17th December 1919. 5 killas up till 28th December 1919 one killa daily.	Harvested on— 4 killas on 3rd May 1920. 4 killas on 6th May 1920. 2 killas on 7th May 1920. 4 killas on 8th May 1920. 1 killa on 28th April 1920.	Ordinary soil. No manuring.
3	Rai Bahadur Lala Sewak Ram of Gangapur.	Acres. 42	0	818	0	19	20	From 6th to 13th of November 1919.	Between 1st and 7th of June 1920.	Soil good. No manure used, except one acre which was green manured and gave the same average yield.
4	Munshi Khair Din of 206, B. B.	35	12	64	0	14	8	2nd December 1919.	About 30th April 1920.	Maira. No manuring.
5	Chaudhri Imamud-din of 196, R. B.	35	12	64	...	14	8	14th of Katak 1976 Sambat.	15th of Bisakh 1977.	No manuring ...
6	Lala Uttam Chand L. Ag. of 3, R. B.	32	12	63	32	15	26½	17th of December 1919.	30th April 1920 to 17th May 1920.	Loamy. No manuring.
7	S. Bishan Singh of 213, R. B.	A. K. 17 4	...	350	0	20	0	5 acres on 10th November 1919. 7 acres on 20th November 1919. 5½ acres on 1st December 1919.	From 20th April 1920 to 5th May 1920.	Sandy Loamy. Manure applied in 7 killas at the rate of 8 carts (about 15 mds. per cart) per acre.
8	Lala Phiraya Ram of 224, R. B.	4 3	12	58	0	13	3	1st January 1920	5th May 1920 ...	Ordinary kalrathi. No manuring.
9	Sardar Hari Singh of Vabalee. 238, R. B.	5 4	10	101	0	18	6	20th Maghar 24th Katak.	20th Bisakh ...	No manuring ...
10	S. Jodh Singh of 118, G. B.	2 1	16	54	0	24	0	7th Katak ...	20th April 1920...	No manuring ...

No. I.

TYPE 8-A GIVEN OUT TO ZAMINDARS FOR TRIAL, RABI 1919-20.

Cultivation and Interculture.	Previous crop.	Number of irrigation with dates.	How it compares with type Punjab XI and other local mixed wheats in the growers' opinions.	Remarks by the zamindars about this wheat.
6 ploughings in 3 killas. 4 ploughings in 2 killas. No harrowing.	Cotton	6 waterings on— 7th November 1919, 6th January 1920, 13th February 1920, 12th February 1920, 3rd March 1920 and 6th April 1920.	...	Shedding of ears is the only defect.
8 ploughings and one harrowing with B. Harrow.	Cotton and Toria.	3 waterings to 13 killas and 4 waterings to 2 killas.	No comparison ...	Thinks 8-A to be a good wheat.
Out of this area spring tine cultivator was twice used in 5 acres of khud kasht.	Cotton	3 waterings on— Between 23rd December 1919 to 29th December 1919. Between 16th January 1920 to 19th January 1920. Between 1st January 1920 to 4th February 1920.	It has just given a little more than other varieties, it is not much superior to type XI or No 17. I would class them to be of nearly the same kind in giving yield.	
Ploughings once Raja thrice Desi, No harrowing.	Cotton	4 waterings in January, February, March and April 1920. It was sown late.	Equal in outturn to Punjab XI, but is better than Punjab XI for eating.	It is better than other mixed wheats.
6 ploughings ... No harrowings.	Cotton and wheat.	3 waterings	Outturn less than type XI. Lodges very quickly. Straw weak.	Type XI is better than 8-A in every respect.
4 ploughings before sowing. Twice plouged for sowing.	Wheat	3 Irrigations, 3rd January 1920, 26th February 1920 and 10th April 1920.	It was not compared with any other wheat as the seed arrived late. It was sown with the object of multiplying seed only. The tenants are showing tendency to grow it next year. Comparative test will be made next year.	
6 ploughings ... 3 harrowings.	Wheat and cotton.	7 acres twice on 10th January 1920 and 5th March 1920, 10½ acres on 3rd January 1920, 26th February 1920 and 31st March 1920.	It did as well as type XI as regards yield.	No difference in yield when compared with Punjab XI. He likes it owing its good baking properties.
4 ploughings and 1 harrowing.	Wheat	2 waterings in February and April.	Thinks it to be a good wheat and the outturn is equal.	
8 ploughings ... No harrowing.	Cotton and wheat.	3 waterings	Better than Punjab XI in the following respects :— (1) Greater in weight. (2) Looks beautiful. (3) Outturn is higher. (4) Easily threshed. (5) Very good for eating. 8-A is very good wheat, gives better outturn when grown on large scale.	
10 ploughings ... 2 harrowings with B. Harrows.	Cotton	4 waterings	He considers 8-A superior to all other wheats including type XI.	

13423

STATEMENT No. II.

Statement showing the comparative test of wheat type (Triticum vulgare) No. 11 and 8-A in tenants and under direct cultivation area. Rabi 1920.

No. of square.	Variety.	Area.		Actual outturn.			Outturn per acre.			Remarks.
		Kanals.	Marlas.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.	
8	No. 11 ...	16	5 2/9	66	27	0	32	32	1	Soil regular to some extent 8-A attacked by white ants more than 11 by 2 per cent.
	8-A ...	16	9 7/9	64	30	0	31	16	10	
9	No. 11 ...	10	11	42	24	0	32	12	2	Attacked of white ants more in case of 8-A. Land was irregular, poor in case of 8-A.
	8-A ...	10	11	41	10	0	31	11	3	
17	No. 11 ...	20	0	70	3	0	28	1	3	Soil somewhat even Attack of white ants more in case of 8-A.
	8-A ...	20	0	67	3	0	26	33	3	
13	No. 11 ...	12	0	33	20	0	22	13	5	Land was quite irregular.
	8-A ...	12	0	30	13	0	20	8	11	

Average outturn is as follows :—

	Mds.	srs.	chs.
No. 11	28	22	0
8-A	27	39	7

Other treatments being similar.

8-A lodges more than 11. This year season was good for 8-A.

STATEMENT No. III.

Statement showing the comparative results of American cotton sown on different dates in square No. 9, Kharif 1919-20.

No. of plot.	No. of sub-plot.	Date of sowing.	Area sown.		Actual outturn.			Outturn per acre.			Number of irrigations given.	Remarks.
			Kanals.	Marlas.	Maunds.	Seers.	Chataks.	Maunds.	Seers.	Chataks.		
1	a	28th April 1919 ...	3	8	1	35	14	4	18	8	6	
10	a	6th May 1919 ...	4	0	3	11	9	6	23	2	6	
10	b	21st May 1919 ...	4	0	4	38	8	9	37	0	5	
2	a	28th April 1919 ...	3	8	1	11	14	3	2	1	6	
9	a	6th May 1919 ...	4	0	1	30	4	3	20	8	6	
9	b	21st May 1919 ...	4	0	4	3	9	8	7	2	5	
3	a	28th April 1919 ...	3	8	2	11	12	5	16	0	6	
8	a	7th May 1919 ...	4	0	2	28	3	5	16	6	6	
8	b	20th May 1919 ...	4	0	3	4	1	6	8	2	5	
4	a	29th April 1919 ...	3	8	1	10	9	2	39	0	6	
7	a	6th May 1919 ...	4	0	2	16	15	4	33	14	6	
7	b	20th May 1919 ...	4	0	4	9	8	8	19	0	5	
5	a	28th April 1919 ...	3	8	1	34	8	4	15	5	6	
6	a	6th May 1919 ...	4	0	1	28	0	3	16	0	6	Land was uneven.
6	b	20th May 1919 ...	4	0	1	7	5	2	14	10	5	

Average outturn is as follows :—

	Mds.	srs.	chs.
Sown on 28th April 1919... ...	4	2	3
Sown on 6th May 1919	4	29	15
Sown on 20th May 1919 ...	7	1	5

All other treatments being similar.

STATEMENT No. IV.

Comparative results between 'Early and Late' variety (Brassica Campestris) of Toria in Square No. 9, year 1919-20.

Date of sowing.	No. of plot.	No. of sub-plot.	Kind of variety.	Area. Kanals.	Area. Marlas.	Actual outturn. Maunds	Actual outturn. Seers.	Actual outturn. Chataks.	Outturn per acre. Maunds.	Outturn per acre. Seers.	Outturn per acre. Chataks.	Number of irrigations given.	Remarks.
9th September 1919.	20	*a*	Late	1	17$\frac{3}{9}$	5	19	0	23	21	62	Germination too thick.	
9th September 1919.	20	*b*	Early	1	17$\frac{3}{9}$	5	32	0	24	37	42		
9th September 1919.	20	*c*	Late	1	17$\frac{3}{9}$	5	26	0	24	11	72	Germination too thick.	
9th September 1919.	20	*d*	Early	1	17$\frac{3}{9}$	5	23	0	23	38	92		

Average outturn per acre is as follows :—

	Mds.	Srs.	Chks.
Late	23	30	14
Early	24	17	14

All other treatments were similar.

STATEMENT No. V.

Watering experiment with 4-F. American Cotton in (Gossipium Herbaceum) Square No. 9, Kharif 1919-20.

No. of plot.	No. of sub-plot.	Treatment given.	Area. Kanals.	Area. Marlas.	Actual outturn. Maunds.	Actual outturn. Seers.	Actual outturn. Chataks.	Outturn per acre. Maunds.	Outturn per acre. Seers.	Outturn per acre. Chataks.	Number of irrigations given.	Date of 1st watering.	Remarks.
1	*b*	Watered in July.	3	6	1	12	14	3	8	3	5	7th July 1919.	
2	*b*	Watered in June and July.	3	6	2	0	5	4	34	11	6	20th June 1919.	
3	*b*	Watered in May, June, July.	3	6	2	9	9	5	17	2	7	25th May 1919.	
4	*b*	Watered in July.	3	6	1	25	9	3	38	15	5	7th July 1919.	
5	*b*	Watered in June and July.	3	6	1	31	1	4	12	4	6	20th June 1919.	
6	*b*	Watered in May, June, July.	3	6	2	1	9	4	37	12	7	25th May 1919.	

Average outturn is as follows : —

	Mds.	Srs.	Chks.
Watered in July	3	23	9
Watered in June, July ...	4	23	7
Watered in May, June, July ...	5	7	7

STATEMENT No. VI.

Statement showing the implements (locally made) sold at Lyallpur during the year 1919-20.

Bar Harrows	341
Drag Harrows	1
Kharif Drills	61
Rabi Drills	120
Lyallpur Hoes	79
Munna Markers	33
Miscellaneous	1,642
	2,277

APPENDIX III.

Annual Report of the Agricultural Chemist to Government, Punjab, Lyallpur, for the year ending 30th June 1920.

Part I.

Staff.—M. Barkat Ali, Assistant in charge of Bacteriological work, proceeded on leave on 24th November 1919. Mr. S. M. Nasir officiated for him but the absence of the former has necessarily caused a considerable interruption in this class of work. Mr. D. K. Ambekar, M. Sc., was granted sick leave on 12th September 1919. L. Parmanand, M. Sc., was appointed temporarily in his place.

1. *Provincial work.*—An abstract of the routine analyses undertaken is given below. Of these, work for foreign departments and private individuals amounted to 2 1 samples against 68 of the last year. Proposals have been sent to Government for permission to charge a fee for work done for private individuals, enquiries from whom are becoming inconveniently numerous, and, as will happen when such references are made at no expense to the individual, are not always of a seriousness to justify the time demanded and the dislocation of important research work involved.

Foods	...	...	109
Manures	...	...	6
Oil-seeds	...	...	10
Soils	...	...	71
Sugarcane	...	...	25
Total			221

In addition to these 850 individual samples were analysed for work in connection with the chemical investigations proceeding in the Chemical Laboratory. These figures do not include the work carried on in connection with problems of pure research, and when compared with previous years are a sufficient indication of the growth of purely routine work. It cannot be too strongly emphasized that such work as this—necessary as it may be—should not be allowed to interfere with the progress of research, on the results of which alone a safe foundation for agricultural progress will be made. It is only by a liberal increase of staff enabling the concentration of the whole of the energies of a man on the particular problem he is investigating that good results can be expected.

2. *Soil surveys.*—The proposals forwarded to Government for the institution of a properly organised soil surveying staff were under consideration during the year under report. Only incidental work could consequently be undertaken.

3. *Reclamation of barren land in Montgomery District.*—The field work which is being conducted at the Ganji Bar Experimental Station is fully described in Part II of this report.

Progress has so far been very slow, but experience is being gained of the best method of working the soils under conditions of ordinary Zamindari farming and with power cultivation, and valuable indications of the methods which are likely to prove most successful have been obtained. So far, however, no crop worthy of the name has been raised on Bara soil.

The laboratory work in connection with the above has been mainly confined, through lack of staff, to estimation of the degree of flocculation produced by the addition of gypsum in the field, and to observations on the succession of bacterial and algal flora when these soils are kept saturated with water. The luxuriant growth of algae noted after the action of a class of bacteria which removes sulphur compounds from the soil is most marked and is worthy of careful investigation.

4. *Soil moisture.*—(*a*) In the field, work was confined to a determination of the moisture distribution underneath a watercourse by the method of horizontal borings from an observation well. The results are of considerable interest but will need an elaborate mathematical analysis before it will be possible to isolate all the factors determining the rate of seepage.

(*b*) The main directions in which laboratory investigations have been pushed are the following :—

(1) The study of the colloidal properties of the clay in soils by compressibility measurements.

(2) Determination of the vapour pressure curve for water in soils.

(3) Investigation of the effect of the osmotic pressure of the soil solution on the moisture equilibrium.

With the knowledge obtained by the above investigations it is now possible to put forward a fairly complete theory of the statics of moisture equilibrium in the soil. A paper in which will appear a more or less complete theoretical treatment with a short account of the experimental work so far conducted has been prepared and is in the press. An equation which will determine the distribution of moisture above a saturated soil has been developed. A consideration of the relations between the salinity of the sub-soil water and the amount of irrigation water applied enable a rough estimate of the percolation from an irrigated field to be made. When the results of further analyses are available it is hoped to be able to put forward an estimate with more considerable accuracy. From the data so far available it appears that direct seepage from channels will only account for about one half the amount of water annually reaching the sub-soil. The lining of a complete canal system would then only postpone the date at which water-logging would take place and ultimately the only method of combating the evil would be by drainage.

5. *Green manuring experiments.*—A full description of the work is given in Part II. Last year's results were confirmed. The plots treated will now be left for the estimation of the residual effect of the treatment. The investigation is now being extended to gain knowledge under barani conditions at Gurdaspur.

6. *Bacteriological investigation.*—Beyond the results of nitrogen-fixation which will be found in Part II, there is nothing to report.

7. *Other investigations.*—The sullage disposal plots were treated with applications of sullage at various stages of dilution for the first time. It is at present too early to draw any conclusion from the results obtained, but it may be mentioned that the worst results were in all cases obtained by the use of the most concentrated sullage. The experiment will have to be continued for several years before any final conclusion will be justified.

B. H. WILSDON,

Agricultural Chemist to Government, Punjab.

APPENDIX IV.

The Annual Report of the Entomologist to Government, Punjab, Lyallpur, for the year 1919-20.

I.—General.

Staff.—I was appointed to the post of Entomologist to Government, Punjab, and joined on the 30th September 1919. Lala Madanmohan Lal was in charge of the Entomological Section till 30th September 1919.

Lala Salig Ram, Demonstrator, left service on 6th September 1919; since then the post has remained vacant, and consequently much of my time that could have been devoted to research was taken up by teaching.

The section is undermanned and requires strengthening.

Library and Laboratory.—An up-to-date reference library is the backbone of teaching and research. Although during the last six months the number of Entomological publications subscribed for has increased from one to about a dozen yet it is far from being what is desired. Extension of the laboratory is a pressing need of the section. Laboratory equipment is very poor both for teaching and research Some very valuable breeding experiments were ruined for want of a proper insectory.

Papers, etc.—Material for Entomological publications is accumulating. The following papers are ready for communication :—

(1) Life history, Habit and Control of *Euphalerus citrii*.

(2) Observations on the Oviposition of *Microbracon* spp. (Parasites of cotton bollworm).

II.—Entomology.

Cotton.—During 1919 cotton remained almost free from bollworm attack. The failure of the cotton crop in the Colony (Lyallpur Sargodha, Montgomery) led to the general impression that *Sundi* was responsible for it, but in all cases thorough investigation proved that the misfortune was due to causes other than insect attack.

The parasites of the bollworms were established at Lyallpur and Hansi early in the season and parasite boxes distributed to all cotton-growing tracts. This work was taken up on a large scale at Ferozepore, where American cottons were introduced for the first time.

Study of the bionomics of *Microbracon* has been taken up and some points of very great value have already been discovered.

This year, so far, no report of bollworm attack has been received, and at Lyallpur bollworm is negligible. Preparations for distribution of parasite boxes are being made both at Lyallpur and Hansi.

Myllocerus blandus appeared in certain tracts, but was not bad on cotton. Maize as trap crop was popular with the zamindars in Piranwala locality (for minor pests of cotton, see Part II).

Mango.—Mango hopper was bad as usual. Extensive spraying experiments were conducted at Baghbanpura and Ajudhiapur (Lahore). Inspite of the fact that the year was a bad fruiting year our demonstrations were convincing. In one garden where only 40 trees were sprayed the owner, for the first time after 5 or 6 years, realized Rs 500. In the garden at Ajudhiapur the following figures give some idea of the efficacy of spraying :—

Untreated trees (used as control).	*Sprayed trees.*
30 per cent. (25 trees), good fruit.	80·3 per cent. (57 trees), very good and good fruit.
30 per cent. (25 trees), little fruit.	15·5 per cent. (11 trees), little fruit.
40 per cent. (36 trees), no fruit.	4·2 per cent. (3 trees), no fruit.

Citrus.—Maltas and oranges in the orchards where spraying was done in 1918 did not suffer so badly from *Euphalerus citrii*, but complaints of rather serious nature were received from owners of some other gardens. Effective spraying operations were carried out in gardens at Gujranwala and Sargodha. Sardar Jewa Singh of Sargodha realised Rs. 300 from his orchard in 1918-19 and in 1919-20, when his orchard was sprayed his income from the sale-proceeds went up to Rs. 1,200. As the result of the splendid victory that we have achieved against this insect—which at one time threatened the citrus industry in the Punjab—we have been instrumental in popularising spraying in fruit orchards, and a number of fruit growers, convinced of the efficacy of this method, are willing to go in for complete spraying outfits. It is desirable that local agricultural, or co-operative authorities, or District Boards should help the fruit growers in providing them with proper machinery for spraying. The prices of fruits have gone up so much that there seems no reason why spraying should not be done in India on as large a scale as in other countries.

Sugarcane, maize, etc.—No definite research could be taken up for want of staff. The borer problem is becoming very serious, and it is very essential that a special assistant be given for this work alone. So far the only effective remedy that can be suggested is 'burning of the stubbles.' In stubbles the borer caterpillars hibernate during the winter, and therefore their proper disposal is effective in reducing the number of the moths next season. The following figures were obtained from the stubble collected from the roadside in the farm area at Lyallpur—out of 446 stubbles examined, 49 stubbles contained in all 56 hibernating larvæ, *i.e.*, almost 10 per cent. of the stubbles contained borer, and if half of these caterpillars were to emerge out as

females and each female were to lay 60 eggs, the number of caterpillars will hatch out in sufficient strength to make an effective attack on the young crop. Effective disposal of these stubbles has been advocated for sometime now, yet, without much effect. There is urgent need for strong legislation on this point. "Clean culture" is half the battle won.

Stored Grains.—Various *mandis* and private houses were visited during the last year to study the conditions in stores. Hardly a store in the Punjab was found to be free from insect attack. Jowar grain stored by the Department at Hoshiarpur and Hissar was badly infested. Various preliminary experiments were performed to test the effect of CS2 vapour on the germination of grain. Carbon bisulphide did, to some extent, injure the vitality of the seed The godown at Hoshiarpur was fumigated with a full dose of CS2, but without any apparent discomfort to the insects, HCN gas, in full dose, was also tried, but without effect. It might have been, because the roof and walls of the building could not be made sufficiently air tight or because the climatic conditions, temperature, humidity, etc., interfere in the toxicity of these poisonous gases. Experiments to investigate the influence of temperature in fumigation were started, but had to be given up as the Agricultural Assistant in charge went on leave. This problem is of immense importance and I have already asked for an assistant to work on insecticides and fumigants.

Parasites.—Impressed by the increasing importance of parasitic insects in Agricultural Entomology, and the difference of opinion as to their efficacy in checking pests, I have devoted my attention to this work. As a concrete example extensive experiments have been designed to check the efficacy of *Microbracon* in fighting the bollworm of cotton. Some very interesting and important facts have already been obtained and the work is becoming increasingly interesting.

From the various stages of the cotton bollworm alone we have bred out 13 different species of parasites, other pests of cotton account for 16 more, and from different pests such as mango hopper, citrus psylla, bean fly, various leaf minors, etc.,—in all 37 hosts—we have bred out 45 different parasitic insects.

Rats.—Numerous complaints from agriculturists, horticulturists, Irrigation Department, etc., were received against rats. The Demonstrator in Zoology was in charge of this problem, and since his departure, we had not the staff to follow his work. In cases of serious complaints steps were taken to check the pest.

Insect parasites of man.—Application of kerosine oil was suggested to a student infested with *Phthirius pubis*. The remedy proved very effective. Proper baths in the College will be the best precautionary measure.

III.—Sericulture.

A separate report embodying the proposals for the extension of sericulture will be submitted shortly. Silk seed reared in the

province during 1920 was 1,000 ounces, as against 872 ounces in 1919. The Entomological Section was responsible for the distribution of 600 ounces, as against 472 ounces in 1919. (Sheikh Ghulam Sadiq of Amritsar distributed 400 ounces each year.) The work was done in 52 schools, of which 8 were new. The highest yield per ounce reared in schools was 14 seers of dry cocoons which brought the teacher Rs 76-8 as net income, and a substantial prize.

It is a good source of income for the poorly paid teachers if they only knew it. A definite policy and mild persuasion on the part of Educational authorities, recognition of good work and condemnation of bad work will give a great impetus to silkworm rearing. School teachers guide the villagers in these matters.

In all 411 ounces was reared by 271 men under the supervision of the Entomological Section; 117 new rearers were initiated into the work; 199 ounces was arranged for through private agency of some silk dealers.

Sericulture was started for the first time in three new districts—Rohtak, Karnal, Shahpur, and help given by the District authorities is acknowledged. The Deputy Commissioner, Shahpur, has taken a keen personal interest in the work, and the results from that district are very encouraging.

Successful experiments on rearing silkworms in huts, erected for the purpose, on the banks of the Upper Bari Doab Canal were tried through private agency.

Seed received from France was on the whole of poor quality; 100 ounces ordered from Chebrier failed to hatch. This has brought down the average yield per ounce—

Highest yield per ounce	School	14 seers.	(dry cocoons).
	Rearers	17 seers.	,,
Average yield per ounce	School / Rearers	5·7 seers.	,,

Census of the mulberry trees growing on the banks of the Upper Bari Doab Canal has been taken and plantations will be fully utilized during the next year or so. Arrangements are being made to have definite estimate of the number of mulberry trees growing in various districts where sericulture is possible.

Lala Madanmohan Lal has mainly been responsible for sericulture, and the Director of Agriculture has expressed in high terms of his 'personal interest and tact' (Report for 1918-19); and, indeed, much tact is required in fostering a new industry amongst people, indifferent and slow. His departure for England will leave us without his experience and knowledge of the people, and his grasp of the problems of sericulture. I, however, trust that fully compensated we shall be, on his return from the West, equipped with new ideas and modern methods of scientific silkworm rearing.

With genuine pleasure I record my appreciation of the manner in which some of my assistants have taken to research in that real scientific spirit, zeal, and enthusiasm that sets at nought the artificial boundaries of holidays and working days, college hours and after college hours (though not without discomfort to some of the laboratory attendants). Lala Umrao Bahadur has shown wonderful plasticity of mind for new ideas and new methods and is doing really first class work on cotton bollworm and its parasites. He possesses qualities essential for research work—precision and perseverance. I also commend the work done by Lala Dina Nath on Citrus Psylla. He is responsible for making spraying popular in citras-growing tracts.

M. AFZAL HUSAIN,

Entomologist to Government, Punjab, Lyallpur.

The 14th August 1920.

APPENDIX V.

Annual Report of the Economic Botanist to Government, Punjab, Lyallpur, for the year 1919-20.

Introductory.—I took over charge of the Botanical Section from Mr. Milne on the 4th June 1920, when he proceeded on combined leave.

Cottons.—The year was very unfavourable for all cottons, but Americans suffered much more than desis. Many farmers in canal colonies complained that many early-formed flowers and bolls fell; that bolls which did not fall did not develop or open properly; that the seeds were poorly developed, and that the lint, especially of Americans, was trash. Investigations into the causes were made and a special report was submitted. Big factors in the trouble were excessive growth in July, August and severe drought in September—October. Some interesting information regarding cotton growing and possibilities of improvement was collected.

Eighteen acres as usual were available for cotton experiments in the Botanical Area. Over 50 American and over 70 Indian selections were grown on half to 1/32-acre area plots. Also over 170 other selections and crosses of both Indian and American cottons were grown on smaller areas.

Some of the better yields of Indian types were as follows :—

Name and number of cotton.	Area.	Details of watering after September.	Kind of soil.	Outturn per acre.	Remarks.
				Md. S. Ch.	
G. I. Mollisoni 30 ...	1/12	10th September 1919; 4th October 1919; 29th October 1919; 11th May 1912.	Fair loam ...	22 28 0	
G. Sanguineum var minor 27 ...	1/2	1st September 1919; 15th September 1919; 9th October 1919.	Rather sandy loam.	18 28 0	
Ditto ...	1/2	...	Fair soil	13 15 0	
Ditto 124 ...	1/7	10th September 1919; 4th October 1919; 29th October 1919; 7th November 1919; 5th December 1919.	Fair loam	18 32 0	
G. Neglectum 109 ...	1/7	Ditto	Fair sandy loam	16 8 6	
G. Neg. Roseum 1 ...	1/2	6th September 1919; 16th October 1919 and 19th November 1919.	...	16 3 4	
G. Indicum var. Mollisoni 22 ...	1/7	10th September 1919; 4th October 1919; 29th October 1919; 7th November 1919 and 5th December 1919.	...	16 8 0	

One maund = 40 seers = 82 lbs.

Many other selected Indian cottons gave 12 to 17 maunds per acre under different conditions of watering, soil, etc.

Americans on the Botanical Area suffered much more than Indian cottons, the better yields were as follows :—

Name and number of cotton.	Area in acre	Details of watering after 1st September.	Kind of soil.	Outturn per acre.	Remarks.
				M. S. Ch.	
297-F. Acclimatised American.	1/14	6th September 1919; 19th September 1919; 1st October 1919; 16th October 1919; and 2nd November 1919.	Good loam ...	11 23 0	
298-F. Ditto ...	1/14	Ditto	Do.	17 29 0	
168-F. Ditto ...	1/7	10th September 1919; 19th September 1919; 4th October 1919; 29th October 1919; 7th November 1919 and 5th December 1919.	Fair loam ...	10 6 0	
285-F. Ditto ...	½	19th October 1919; 9th November 1919; and 5th December 1919. (More water not available.)	½ good loam, 1/3 sandy loam, remainder fair loam 1/3 of the whole manured 4 years ago.	6 10 0	
275 II-F. Punjab narma.	½	2 in September ... 2 in October.	Good heavy loam	10 16 0	

Regarding cottons handed over to the Agricultural Farm I understand that our Indian selections have done far better than our Americans, and that Mollisoni No. 24 has done best of all. G. Sanguineum No. 28 is also said to have done well indeed.

A comparison of the results got from our Indian Selections with what farmers got from ordinary Indian mixtures would do much to dispel the misconception that nothing has been done on desi cottons.

285-F. and 4-F. Americans were grown side by side on 28 plots about 1/4 acre area each. The average outturn of the 14 plots of 285-F. was 5 maunds 5 seers and 6 chhataks, and that of the 14 plots of 4-F. was 4 maunds 5 seers and 6 chhataks. Half the number of plots of each type got two waterings in September, 2 in October and 2 in November while the others got 1 watering in September, 1 in

October and 1 in November. In both the cases the average yield of 285-F. is better than 4-F. especially in the case of lighter waterings where the difference was one maund 21 seers per acre in favour of 285-F. Our results in this and past years all indicate that 285-F. is a heavier cropper and more drought resistant despite its longer and finer lint. These yields are both very small, but a farmer in Chak 114, S. B., Lower Jhelum Canal, growing 285-F. on one acre of fair land in ordinary conditions got 12 maunds and 10 seers from 285-F. while his 4-F. growing around it gave far less outturn. Another farmer of Chak 232, R. B., Lower Chenab Canal, states that he got 12 maunds per acre from 285-F. and 6 maunds per acre from 4-F. These men sold the cotton of 285-F. to us.

Messrs. Ralli Brothers bought a consignment of 10 bales of 285-F. lint from us at Rs. 57 per maund, while 4-F. was selling at Rs. 44 per maund. Before buying this cotton they sent a sample to their Liverpool Office for valuation.

Their report is as follows:—

"The cotton in question has not got the general appearance of genuine American, but its staple compares very well with it, and it is very fine and strong. It is classified as equal to about fully Middling Memphis good 1·1/16" staple which was selling on 21st April on the pot at 2½*d*. above the corresponding futures.

On the basis of East Indian cotton the sample in question cannot be compared with the other American cotton grown in the Punjab as it in much superior in staple. From all the above it is clear that the cotton is question, provided it is kept well up in staple, will find ready buyers at substantially higher prices than those offered for ordinary Punjab American. In our opinion, therefore, cultivation of similar seed should be encouraged"

Two bales of 285-F. and 1 bale of 4-F. were sent to the British Cotton Growing Association last year. The valuations came too late for last year's annual report. They were:—

A 4-F. Very useful cotton with hard staple valued at 17·75*d*.

B 285-F. (grown by a farmer). Good hard silky cotton value about 19·75*d*.

C. 285-F. (grown in the Botanical Area) "About equal to fully good middling American; about full 1·1/8" staple very useful cotton." Value 23·25*d*.

Value of Tinnevelly at this date 18·85*d*.

Value of fully middling futures 18·75*d*.

"That both B and C could be used in Lancashire; preference being given to C if it could be produced in large quantities." "That you will continue the good work you are doing with the types "B" and "C," so that it may be possible for India to produce cotton similar to that which is extensively used in this country."

Twenty-one samples of American selections and 12 samples of desi cotton were sent to Messrs. R. D. Tata & Co., Bombay, for valuation. Fine scind America and fine cambodia were selling at Rs. 540 and Rs. 620 per candy (784 lbs.) respectively when they were taken as the bases for valuation. 285-F. is valued at Rs. 700. "It is good for 50s. The cotton is curly, though the staple is very long and strong. It resembles middling."

289-F. is valued at Rs. 680 "Its staple is long and silky. It is good for 50s."

Other selections 163-F, 281-F, 237-F. and cross $\frac{A1}{5}$ are valued from Rs. 625 to Rs. 650.

4-F. comes very low. It is valued at Rs. 520 and is good for 20's "Its staple is fairly long and fibres are weak."

All these American selections have been reported on better than 4-F. (for valuation of desi cottons see part II). This year one bale of 285-F. and one of 4-F. have been sent to the British Cotton Growing Association for valuation.

Finally the year's work convinces me more than ever that the evolution of improved crops and their testing is the work of a specialist, and I hope to see staff soon to deal with cottons as experience has shown it should be dealt with. If handled rightly much can be done to improve the crop of the province, otherwise the result can bring no credit to the Agricultural Department. None of our improvements have come accidentally.

Wheats.—The area under wheats this year was a little over 19 acres and consisted of 355 different sowings of 36 new types of Punjab wheats, 122 selected crosses, 25 Punjab classified wheats and other wheats selected during the wheat surveys carried out in the last 3 years.

Of the 36 new types 8-A, 8-B, 9-C, 16-A and 17-B were tested against Punjab 11 on 1/8- acre plots in four sets in the new area. Pusa 12 and crosses Nos. 2 and 3 also were grown with them.

Three-fourth of the land was medium loam and ¼ sandy loam. Comparative yields of these and other wheats tested on the Botanical Area are given in statements in Part II.

8-A has given an average of 32 maunds 18 seers, against Punjab 11, which has yielded 30 maunds and 31 seers per acre. It has thus again maintained its position of superiority over other selected wheats tried in the Botanical Section and outside in the Punjab.

It was tested by the Deputy Director of Agriculture, Hansi, 4th time this year in duplicate sets against Punjab 14 the predominating wheat of the circle and the results received from him show that it has yielded an average of 30 maunds 12 seers 8 chhataks per acre, while Punjab 14 has given 27 maunds 31 seers 4 chhataks, *i.e.*, 2 maunds 31 seers 4 chhataks more in favour of 8-A. Punjab 11, which was

tested similarly with Punjab 14 has given 2 maunds 6 seers 4 chhataks more than Punjab 14 per acre. 8-A., therefore, has indirectly done better than Punjab 11 by 25 seers.

At Gurdaspur Farm varietal tests of our wheats and of some selected Pusa wheats were made on an extensive scale this year. From the results got it is clear that 8-A. has done better than other types under trial both on chahi and barani lands.

8-A. has been grown on the Sargodha Seed Farm for the last 3 years and has again proved the best yielder this time. It is very much liked by the zamindars, and I am told that about 3,000 maunds of it have been stored by the Depury Director of Agriculture, Gurdaspur, for distribution next year.

8-A. was tested in the Hoshiarpur District against Pusa 12 and local wheats on zamindari lands, and it has turned out to be the best. Arrangements have been made for giving it to the zamindars next season.

The Agricultural Assistant in charge of the district work, Sialkot, reports that 8-A. has done exceedingly well and is found better than Pusa 12.

The Professor of Agriculture carried out the varietal tests of 8-A. and Punjab 11 again this year on the Lyallpur Farm. In square No. 32 on 6 acres with 2 and 3 irrigations in later sowings, 8-A. has beaten Punjab 11 by 18½ seers.

In square No. 26 Punjab 11 has yielded 1 maund 11 seers more than 8-A. this year. But in previous years 8-A. has been giving higher outturn than Punjab 11,—*vide* statement given below.

The results obtained in this square from this year's test cannot therefore be considered comparable.

Statement of comparative outturns of varietal tests of 8-A. and Punjab 11 made by the Professor of Agriculture on square Nos. 26, 32 and Tenants Area.

Type No.	1916-17.		1917-18.		1918-19.				1919-20.		
	26 square.	Tenants Area.	26 square.	43 square.	Tenants Area.	26 square.	43 square.	Tenants Area.	26 square.	32 square.	Tenants area.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
8-A ...	23 38	15 28	20 0	15 33	12 29	22 35*	24 14	19 17	27 24	27 11	25 18
Punjab 11	23 0	14 38	19 6	11 22	13 26	23 8	25 37	20 20	28 35	27 23	25 29

* 8-A was 20 per cent. damaged by white ants.

In the tenants area Punjab 11 has no doubt shown an increase of 11 seers over 8-A. on an area of about 28 acres. But considering that 8-A. was badly attacked by white ants in some of the plots, this difference becomes immaterial. 8-A is preferred by the zamindars to Punjab 11, because it has hard amber coloured grain and is much better for making country bread. In the last milling and baking tests also it has proved superior to Punjab 11.

Crossings.—Testing of the selected crosses was continued on previous lines.

The milling and baking tests of our selected wheats were carried out again this year. In this connection I may state that our work has been aimed at giving us a comparison of the economic values of our different types of wheat, but our investigations into some of the factors involved (*i.e.* baking outturns) have not gone far enough to enable us to calculate the complete comparative economic values with confidence, therefore the complete calculations are not yet made.

The Directors and Manager of the Pioneer Flour Mills, Shahdara had given us the facilities at their command to have our wheat types milled to show their relative milling qualities, but we found that it was not possible to get accurate data on all points, and this is likely to be the case in future trials in a commercial mill. Accurate data is absolutely essential before we can work out the comparative economic values of our types and be able to recommend the best of them to be grown or continue to cross varieties we have.

Potatoes.—Experiments with scotch potatoes were continued in Simla Hills. They yielded better than the Desi potatoes and the farmers who had grown scotch varieties made a profit of over Rs. 150 more than what they got from the Desi crop. There is considerable demand throughout the province for our improved varieties.

Lathyrism.—Some experiments were conducted on rabbits, etc., to find out the effects of feeding animals on seeds of Lathyrus sativus. Report on the work done has been submitted to the Government and is being printed.

An illustrated pamphlet on the earcockle disease of wheat is shortly expected from the press. A leaflet on red rot in sugarcane has been published.

Other Work.—For work on barleys, grams, dates, earcockle disease, etc., see part II.

JAI CHAND LUTHRA,

Offg. Economic Botanist to Government, Punjab.

APPENDIX VI.

Annual Report of the Agricultural Engineer to Government, Punjab, Lyallpur, for the year ending 30th June 1920.

Introductory.—Mr. T. A. Miller Brownlie was in charge of the section till 8th May 1920 afternoon, when he proceeded on eight months' combined leave when I took over charge from him.

There is an advance in the number of enquiries for plant required for lift irrigation, *viz.*, 40 as compared with 33 in the last year. On account of the present high prices of plant and materials land owners are disinclined to carry out improvements regarding water supply for irrigation, hoping that there will be a fall in the market rates of plant later on. Considering that most of the trained staff went to Military duty, and that a fair portion of the plant was transferred to the Military Department, the work, on the whole, was satisfactorily carried out by this Department. The mechanic borer lent to the Military Department recently returned from Persia, and money for the replacement of the plant sent to Bushire was allotted in March last. Some of the tools required to make up deficiencies have been purchased and endeavours are being made to obtain or make up the remainder as soon as possible.

Well-boring.—The object of the work is to increase the supply of water in ordinary wells by boring. For this class of work 3 well supervisors, 20 well-borers and 20 mates are sanctioned, but 2 borers with their mates and plants, who went to Persia on 1st October 1918, remained there throughout the year under report, and have, as stated above, recently returned. The two boring plants to replace the ones sent to Bushire have been ordered and are expected to arrive soon.

The method of introducing a strainer into a bore made to a considerable depth below the floor of old existing wells, introduced three years ago, in place of the previous plain pipe method, has proved very successful, and is resorted to in wells situated in districts where no impervious stratum in the subsoil is found at a reasonable depth. Although the trouble regarding stoppage of goods and difficulty in obtaining materials combined with high prices of same and also of labour continued throughout the year, yet the outturn of work is satisfactory, the number of bores sunk being 360 as against 349 in the previous year. Successful borings numbered 302, giving a precentage of success of 84·33 against 77·6 in the last year. The number of wells treated with convoluted strainers amounts to 149 against 158 in the previous year, all of which were successful.

Tube wells.—As there was only one mechanic borer with us (who was at the time under training) two ordinary good well-borers were therefore put under training as mechanic borers to bring the number of borers up to sanctioned cadre, and one of them, Raja Ram, took independent charge of the Veterinary College Lahore tube well. Both of the men have now returned to their substantive posts on return of the mechanic borers lent to Army Department.

The following tube wells were in progress during the year :—

1. *Jalalabad Tube Well in Mamdot Estate in Ferozepore District.*—Reboring was finished in March last, but further operations are being delayed till arrival of a new type of pump from England, which is expected in the course of a month or so.

2. *Lyallpur College Tube Well.*—Sinking of masonry sump is in progress and boring work will be started as soon as the required number of 18″ casing pipes arrive from England.

3. *Muzaffargarh Tube Well for Date Palm Plantation of Economic Botanist to Government, Punjab.*—Boring was finished in October last, but the pumping plant was received from England only in May last ; the work is nearing completion.

4. *Veterinary College Tube Well at Lahore.*—Boring was finished in May last, but the pump ordered from England about a year ago has not yet arrived, though it is expected soon. Delay in completing the work is therefore unavoidable.

5. *Bahawalpur State Tube Well.*—Boring is in progress, and, as all the strata found so far are unsuitable, we will therefore have to go still deeper.

6. *Dera Ismail Khan.*—A deposit of half the estimated amount for installation of a second tube well at Dera Ismail Khan has been received and work will be started as soon as a boring plant is available.

7. *Gujrat.*—Sanction for installation of a tube well in Gujrat has also been received, but the work has been temporarily postponed at the request of the Deputy Commissioner, pending decision of a new site for the Agricultural District Board Farm.

Implements.—Attention has been devoted to the design of a suitable power boring machine for Punjab soils. Various experiments have been made to overcome unsuitable features in existing types. Trials will be continued during the next year till a definite result is achieved.

Design for bhusa (straw) making plant is in progress. This implement shows an improvement on the types now in vogue and further improvements in this direction are anticipated.

Thirty cultivators of the new type mentioned in last year's report have been ordered from the Empire Engineering Co, Cawnpore, and will be tried on receipt therefrom, after which, if found suitable, they will be recommended to the public for trial.

A cart of the new type was sent to Lahore for test. Result is still awaited. Applications from many persons have been received asking to be supplied with the new type of cart, but unless the sample is approved by duly qualified experts the carts cannot be made and sold to them.

The seed drill mentioned in last year's report is still in its experimental stage.

Masonry Works.—The masonry well at Ganji Bar Experimental Station is finished.

The construction of a new Agricultural Workshop at Lyallpur was started in December last and is nearing completion.

Sanction for construction of a Seed Godown at Kala Afghanan for Co-operative Credit Societies was received, but as the work could not be executed at the sanctioned rates a revised estimate has been submitted. The work will be started on receipt of sanction of the revised estimate.

Similarly, work on construction of a small Ginning Factory at Hansi will be started as soon as the revised estimate has been sanctioned.

Proposals for providing roof, etc., for sugar boiling plant at Gurdaspur have been submitted and the work will be commenced as soon as the sanctioned estimate is received.

Sugar boiling plant at Gurdaspur, as mentioned in last year's report, was tried last winter.

Detailed drawings prepared throughout the year number 31.

P. A. McCORMACK,

Agricultural Engineer to Government, Punjab.

Appendix A.

WELL-BORING.

Serial No.	Name of District.	Wells.		Remarks.
		Number of Bores.	Successful.	
1	Multan	25	24	Ludhiana Circle percentage of success 88·25.
2	Ferozepose	40	33	
3	Lahore	46	41	
4	Ludhiana	25	22	
	Total ...	136	120	
5	Jullundur	15	14	Jullundur Circle percentage of success 77·7.
6	Hoshiarpur... ...	37	23	
7	Gurdaspur	14	12	
8	Gujranwala ...	5	5	
9	Gujrat	14	4	
10	Shahpur	1	1	
11	Sialkot	28	21	
12	Amritsar	21	21	
	Total ...	180	101	
13	Gurgaon	24	21	Rewari Circle percentage of success 86·26.
14	Ambala	13	8	
15	Karnal	49	45	
16	Rohtak	8	7	
	Total ...	94	81	
	GRAND TOTAL ...	360	302	Percentage of success 84·33.

Appendix B.

Details of strainers used in wells in the Punjab.

Circle.	District.	Number of Strainers.	Average yield of Well before strainer was used, gallons per hour.	Yield after Strainer was used in gallons per hour.	Average cost per Well.
					Rs.
Prior to July 1919.					
Jullundur	Hoshiarpur	83	637	2,200	141
	Amritsar	45	760	2,650	173
	Gurdaspur	13	930	2,940	153
	Jullundur	1	930	3,000	150
	Gujranwala	23	510	2,475	139
	Sialkot	39	827	3,350	124
Ludhiana	Montgomery	12	630	2,600	150
	Lahore	104	656	2,320	136
	Multan	41	530	2,240	140
	Ferozepore	21	856	3,760	113
	Ludhiana	21	530	2,600	144
Rewari	Gurgaon	8	600	2,300	150
	Karnal	24	650	2,720	117
	Ambala	8	410	2,350	149
Since July 1919 to June 1920.					
Jullundur	Hoshiarpur	12	342	1,150	111
	Gurdaspur	12	1,125	3,975	161
	Gujranwala	5	825	2,450	129
	Gujrat	1	545	1,925	137
	Sial kot	21	375	4,125	141
	Amritsar	25	775	4,675	204
Ludhiana	Multan	6	129	394	207
	Ferozepore	10	150	359	148
	Lahore	17	138	480	228
	Ludhiana	11	61	407	200
Rewari	Karnal	27	712	2,396	98
	Ambala	2	3,000	3,546	99

The average cost given excludes all labour.

APPENDIX VII.

District Report of Gurdaspur Circle for the year ending 30th June 1920.

M. FATEH-UD-DIN was in charge of the circle up to the beginning of April 1920, when I relieved him. This is the largest circle in the Punjab, and comprises all districts except those under the Lower Chenab and Lower Bari Doab Colonies and parts of the Upper Chenab and Upper Bari Doab and also the districts in the south-east of the Province.

There are three Government Farms under the direct control of the Department (Gurdaspur, Sargodha, and Chillianwala) and four are run by the District Boards under the guidance of the Department. In addition to these the Khalsa College at Amritsar has recently started a farm with the object of imparting Agricultural Education to its students. They are all doing well and form the centre of our activities and are a great source of Agricultural development of the districts concerned.

The staff is still limited, and work has been possible in only Hoshiarpur, Jullundur, Amritsar, Gurdaspur, Sialkot, Gujrat and Shahpur on a large and satisfactory scale, though demonstrations have taken place at horse and cattle fairs of several other districts. But it seems advisable to limit the extent of work according to the number of Agricultural Assistants and does not seem prudent to extend it so much that it will be difficult to manage.

The following have been the lines of work adopted :—

(1) Demonstration farms.
(2) Demonstration and sale of improved Agricultural implements.
(3) Sale of improved seeds from our own demonstration farms and starting and supervision of private seed farms.
(4) Demonstration plots.
(5) Cotton auction sales.
(6) Agricultural Associations.
(7) Potato storage experiment at Sialkot.
(8) Methods of combatting crop pests.
(9) Maize and cotton sowing in lines and their interculture.

Demonstration Farms.—There are four District Board demonstration farms existing at —

Jullundur
Beas
Sialkot
Gujrat

and a private farm in Khalsa College, Amritsar.

The Khalsa College farm has just been started, and is in charge of an Agricultural Assistant whose services have been lent to the College. The farm is expected to be under the control of the Department. Hoshiarpur and Ludhiana are also going to start their own farms, but owing to several successive transfers of the Deputy Commissioners in Hoshiarpur they have not been able to acquire the land as yet although it has been selected and marked out, but Ludhiana has been held back on account of lack of a suitable Agricultural Assistant and as soon as I can spare one for that district the land will be taken over. Shahpur and Jhelum districts are also considering the question, but they may have to be disappointed owing to the absence of sufficient staff at present.

The points such farms serve have been explained in the last year's report to which may be added the necessity of growing different crops on such farms to make sure that they are suitable for the locality in which their seed is to be distributed. These institutions are not only Demonstration farms, but they are experimental also as far as the testing of crops is concerned.

All these farms continue to prosper, and, though things have not been bright in Gujrat so far, the District Board has now sanctioned the enhanced scales of pay of the beldars and the usual labour troubles will now be removed. The land of this farm is underlaid with a stratum of almost pure sand, consequently Organic matter is lacking. A good deal of green manuring has been done and will have to be done in future to bring it into suitable condition. Farm buildings are under construction at Jullundur and Gujrat and are under consideration at Sialkot.

The following are the income and expenditure during the year :—

District.		*Income.*		*Expenditure.*
Jullundur		Recently started.		
Beas	...	1,339	...	3,067
Sialkot	...	1,811	...	907
Gujrat	...	751	...	1,312

Chillianwala Seed Farm.—In 1917 10 squares of land were given over to the Department for propagation and multiplication of improved seeds in the Upper Jhelum Colony. As no funds were supplied the land was given out on lease. Last year half of a rectangle was taken over for direct cultivation, but owing to absence of suitable buildings and labour comparatively little work has been possible. New tenants have now been brought to the farm from Sargodha and some buildings have been erected and it is hoped that the farm will soon improve.

Demonstration and Sale of improved Agricultural Implements.—A zamindar, in the first instance, has a very doubtful mind when he sees any of these implements and only takes it for some time on loan. He is taught how to manage and use the implement he takes, but he soon realizes his mistake and pays up the price to keep the implement for himself.

Last year there were about 500 implements of various kinds on loan and again there is a similar number out with the zamindars this year. In spite of the difficulties in the import of new stocks, due to extremely high prices and lack of shipping and the rise of labour in India, the following implements were sold during the year by different firms in this circle :—

Name of Implement.		*1918-19.*	*1919-20.*
Rajah Ploughs	...	81	83
Meston „	...	200	812
Cultivator	}	8	11
Spring Tined Harrow	}		15
Rajah Reaper	...	1	3
Horse Hoes	...	...	15
Rajah Fodder Cutter	...	1	1
Lever Harrow	...	...	1
Hand Hoe	...	8	1
Meston Shares	...	...	440
Winnower	...	...	1

In addition to the above five Rabi drills and 70 Bar harrows from Sargodha and 15 Bar harrows from Gurdaspur Machinery Depôt were sold during the year under report. The total number of Bar harrows sold is 85 against 40 of last year. There has been and still is a keen demand for Meston ploughs in the central districts but, unfortunately the shares which wear off quickly cannot be got anywhere and a large number of ploughs have to fall out of use until fresh stock of shares is in. A much larger number of Rajah ploughs and reapers would have been sold in the Lower Jhelum Colony, but the firms have been unable to stock sufficient number in Sargodha and it was almost impossible to get them from anywhere else.

System of itinerary beldars with some implements in a cart is in vogue in a few districts and has been found to be extremely useful. This affords an opportunity to demonstrate their use even in isolated and out-of-the-way places and attract the attention of all sorts of zamindars.

Demonstration of improved machinery is also given at horse and cattle fairs and at other annual functions. Some District Boards offer prizes for best Agricultural exhibits and also for ploughing competitions during their fairs. This affords a splendid opportunity for demonstration of this kind of work and draws an enormous number of interested spectators desirous of learning their use.

Besides these demonstrations are also given at Gurdaspur and Sargodha and on the District Board Farms at Jullundur, Beas, Sialkot, and Gujrat to interested visitors.

Sale of improved Seeds and private Seed Farms.—The produce from our own farms is almost all used for dissemination and is a source of supply of pure seed every year. The zamindars who grow this seed reserve some for their own requirements and sell the rest either to the Agricultural Department, if the seed has been kept in satisfactory condition and is quite pure, or to the neighbouring zamindars who are glad to get anything better than their own stuff. Next year again the produce of the farms together with the seed purchased from zamindars is given out to other zamindars and thus the sphere of new and pure seed gradually widens.

The seed farms with zamindars are closely watched and inspected by Agricultural Assistants and only such crops which can be guaranteed pure are selected for seed which is purchased soon after harvest at a premium of 2 annas to 4 annas over the market price. This pays the zamindar for his extra trouble in keeping his fields clean and for growing good seeds. Wheat, cotton, and sugarcane are the most important crops of the circle and are being pushed out on an extensive scale. Other crops for which there exists a demand and whose seed is being supplied on a fairly large scale are Australian bajra, Japan sarson, ground-nut maize, and safflower.

Wheat.—So far Punjab-11 has been predominant in the colonies and Pusa-12 in the central districts. But a new variety 8-A has gradually been ousting them both in irrigated as well as Barani tracts and is now being distributed widely. In the year under report at least 3,485,000 lbs. wheat seed No. 11 and 29,520 lbs. of 8-A were with the zamindars in the Jhelum colonies alone (excluding the quantity sold in other districts) and about 239,440 lbs Pusa, 12 was sold in the central districts. For the next year about 246,000 lbs. of 8-A (164,000 lbs. in the colonies and 82,000 lbs. in central districts) and about 205,000 lbs. Pusa-12 for the central districts have been purchased and stored. There is a still greater demand for seed of 8-A which has done best everywhere both in Barani as well as irrigated lands, but owing to shortage of its seed any larger quantity could not be stored. For the rest of the area under wheat in the colonies Punjab-11 has been purchased.

Cottons.—In this circle cotton is mainly grown in the Lower and Upper Jhelum colonies, and owing to very high prices its cultivation increased markedly during this year.

Besides a very large acreage under American cotton the seed for which had been reserved by the zamindars themselves it is estimated that about 32,000 acres in the Lower Jhelum and 1,500 acres in the Upper Jhelum colonies were sown with the departmental seed. The Desi cotton occupies less than ¼th part (18%—20%) of the whole area under cotton in the Lower Jhelum colony, but occupies more than ½ of the area in the Upper Jhelum where the land has not been properly colonised and the water distribution has not been completed.

The following were the areas under cottons in the Lower Jhelum Colony.

1918.				1919.		
	American Area in Acres.	Desi Area in Acres.	Total.	American.	Desi.	Total.
Lower Jhelum Canal,	75,081	14,861	89,942	88,089	18,829	106,918
Imperial Shahpur Inundation Canal ...	76	743	819	3,391	8,584	11,975
Shahpur Provincial Inundation Canal		318	318.	622	1,710	2,332
Total	75,157	15,922	91,079	92,102.	29,123	121,225

The season was very favourable for all cottons in the beginning and the plants made excellent growth throughout, with a promise of a high yield. But in early October and November the leaves, especially those of Americans, particularly 4-F, turned crimson, and the leaves and blooms began to shed with a consequent partial failure of the crop. This may have been due to any of the following causes :—

1. Lack of irrigation during fruiting time.
2. Deterioration of seed.
3. Plant exhaustion.

It is estimated that this year there was at least 20 per cent. increase in the area under cottons in the Lower Jhelum Colony, and if in an ordinary year the crop is given six irrigations it hardly expected to receive more than five this year. But owing to abnormally hot summer it required about seven or eight irrigations, while it could get about five only. Therefore, want of water, together with the intensity of the unusually hot summer, taxed the energy of the plants heavily, and was, I think, the main cause of their failure.

Last year the monsoon continued late thereby causing delayed fruiting. American cottons, unlike the Desis, bear fruits in succession from September to December, but owing to late rains the first fruit was delayed so that on all the early-sown crops the first and the second fruits came together. This heavy call on the plant to mature it together with the lack of irrigation during October exhausted the plants. The case was a little different with the late-sown fields. The fruit came at its proper time and the plants were not heavily laid with bolls as in the case of early sown, therefore they did not do so badly.

Frost during November and December affected all plants, but particularly those which had already been weakened. The average yield was tremendously decreased, and the crop on the whole was estimated to be worth Re. 0-7-0, while the normal is taken at Re. 1.

Cotton Auctions.—As usual for the sale of the American cottons, departmental auctions were held in several markets of the Lower and Upper Jhelum Colonies. This has been the practice in the Lower Jhelum for the last few years, but is a recent introduction in the Upper Jhelum Canal, and only one sale at Bahauddin was held during this year.

The following are the places where sales in the Lower Jhelum Colony were held :—

Sillanwali.

Sargodha.

Bhalwal.

Phulerwan.

Except Sillanwali, where no sale could be held on account of heavy rains and Bhalwal, where bids offered were too low, all others were very successful, and about 12,77,560 bls. of good American cotton were sold, but about the same quantity which was on samples was withdrawn.

Such sales are extremely useful in the new places, but where American cotton has spread and the buyers can get it in large quantities some difficulty in disposing of the stuff collected and graded is beginning to be felt.

Demonstration Plots.—The exact procedure adopted and the effect that such plots have had has been explained in the last year's reports. A very keen demand for such demonstration plots is arising in almost all districts, and we have to strictly restrict their number owing to the paucity of staff but those that have been started have received all attention accompanied with marked success. The fact that the zamindars are themselves earnestly requesting for such help is itself a sufficient proof in its favour. They have so far consisted of farm *versus* local methods of cultural operations only, everything else being similar and the results (average increase of 400 s. per acre by farm method) are astonishing for the zamindars. (Please see statement attached).

Agricultural Associations.—In all districts (except Gujrat), where we have so far been able to extend our work, Agricultural Associations exist. They are all doing well, and very keen and interesting discussions on Agricultural topics take place. Two meetings are held in a year, one in winter and the other in summer. The Association in Gujrat is under consideration and the Deputy Commissioner is taking steps to start it as early as possible and it is hoped that it will be started within a short time.

Potato Storage Experiment at Sialkot.—Sialkot is the centre of potato cultivation in the Punjab, and supplies for Rawalpindi and other Military Stations are met from there. But the tubers stored during summer are greatly destroyed by moth and fungus diseases. To combat these diseases storage experiments were started two years back. In the first year storage in sand proved successful, but during the second year extremely high temperature and the Rhizoctonia fungus destroyed the whole crop. It therefore appears that stored potatoes are destroyed by —

1. Moths.
2. Fungus disease.
3. High temperature.

All the three causes have been kept in mind this year, and the experiment has been arranged in rooms—

(1) Under ground.

(2) Above ground.

The underground room will be out of the direct rays of the sun and the temperature will be comparatively low. Further, tubers have been treated with corrosive sublimate to kill fungus spores and different methods of storage, in bags, under sand, and on wooden racks, etc, etc., are being tried. Daily maximum and minimum temperatures are recorded.

This experiment is of great value, and if successful no less than a lakh of rupees will be saved every year.

Staff.—Except a change in the post of the Deputy Director there has been no change in the staff. M. Fateh-ud-Din, who has been reverted to his substantive post of Extra Assistant Director of Agriculture, has been helping me in general Agricultural work in the circle and takes a part of the heavy office routine. Q. Samiullah and M. Mukhtar Nabi have held the charge of Sargodha and Gurdaspur farms, and have been doing district work in addition. The ever-increasing office work has been willingly borne by my office staff, and M. Barkat Ali, the head clerk, has shown himself to be exceptionally qualified for the post.

M. SULTAN ALI,

Dated 24th July 1920. *Deputy Director of Agriculture,*
1st Circle, Punjab,
Gurdaspur.

Statement showing the results of Demonstration Plots in 1st Circle, Gurdaspur, Rabi 1919-20.

Name of Place	District.	Outturn per Acre in Maunds.		Crop.
		Demonstration Plot.	Cultivator's Plot.	
		Mds. Srs. Ch.	Mds. Srs. Ch.	
Bhagwan ...	Gurdaspur ...	15 0 0	9 0 0	Wheat.
Bhainmillwan ...	Do. ...	10 26 10	8 26 10	Do.
Pakbowal ...	Do. ...	8 0 0	4 20 0	Do.
Lakhan ...	Do. ...	12 0 0	10 0 0	Do.
Khanna ...	Do. ...	15 3 2	12 2 8	Do.
Pindi Umera ...	Do. ...	16 11 6	12 11 10	Do.
Do. ...	Do. ...	19 12 0	12 34 10½	Do.
Baharwal ...	Do. ...	13 10 12	9 26 0	Do.
Norangabad ...	Do. ...	12 10 0	10 0 0	Do.
Bhojpur ...	Do. ...	17 14 12	15 17 9	Do.
Shahbazpur ...	Do. ...	12 2 8	8 15 4	Do.
Chamrial ...	Do. ...	7 28 12	4 33 0	Do.
Ghumtala ...	Do. ...	12 34 10	10 28 14	Do.
Jabal ...	Do. ...	15 0 0	12 12 0	Do.
Bhattian ...	Do. ...	17 14 12	9 26 0	Do.
Bua ...	Do. ...	19 12 0	14 19 0	Do.
Sahlepur ...	Do. ...	14 19 0	9 26 0	Do.
Dhagowal ...	Do. ...	19 4 0	12 34 0	Do.
Chima Kalan ...	Jullundur ...	26 31 0	8 17 0	Wheat, S-A.
Mahatpur ...	Do. ...	25 12 0	16 35 0	Wheat, local.
Chuheki ...	Do. ...	24 15 0	14 30 0	Do. Pusa 12.
Jhugian ...	Do. ...	21 3 8	16 35 0	Do. Pusa 12.
Shahpur ...	Do. ...	18 39 0	12 26 0	Do. local.
Shamshabad ...	Do. ...	17 23 0	13 0 0	Do. local.
Tanda Ura ...	Do. ...	16 35 0	14 12 0	Do. local.

APPENDIX VIII.

Annual Report by Sardar Darshan Singh of Vahali, I.A.S., Deputy Director of Agriculture, Punjab, Hansi, on District Work for the year ending 30th June 1920.

THE main branches of district and demonstration work are the same as those of the previous years and may be summarized under the following heads, namely :—

1. Distribution of the improved Agricultural seeds to the cultivators.

2. Arrangements for the disposal of the produce of the improved seeds by means of auctions, collective sales, or private arrangements.

3. Efforts to multiply the pure and best varieties and their proper storage.

4. Demonstration of best methods of cultivation and the raising of crops.

5. Demonstration of the Agricultural implements recommended by the Department and teaching the cultivator how to use them.

6. Running of Agricultural Associations.

7. Running of demonstration farms, demonstration plots, and seed farms.

8. Supplying general Agricultural information to the cultivator of this circle.

Distribution of the improved Agricultural Seeds.—The advance made in this direction during the year under report is very remarkable. The area under American cotton in Ferozepore District during the last Kharif was reported to be about 30 thousand acres. The actual area sown was, however, not quite so much and was nearer 20 thousand acres. The forecast of the area under this crop in the Ferozepore District is reported likely to be more than double this season.

Cottons.

2. Auctions were organised at Abohar and Kotkapura. The auction at Abohar was a great success, and the cultivators realized the advantages of this system of sale, and the prospect of good profits has encouraged them to sow larger areas. The quality of cotton grown here was very good, and great efforts were made to keep the crop pure, and weeding out of cotton plants of other varieties was attended to with great zeal by the Agricultural Assistant of the district. This resulted in obtaining the highest prices at the Abohar sale as compared to any other place in the Punjab.

The auction at Kotkapura was, however, not quite so successful owing to unopportune rain during the auction days.

The area under American cotton in the districts of Hissar and Rohtak was 1,100 and 1,000 acres, respectively. As the quantity of Kappas expected was not enough to hold auctions arrangements were made with the local factories to pay the cultivators a premium of Rs. 2-4-0 and Rs. 2, respectively, for the districts of Hissar and Rohtak over the Desi cotton rate for the day of the sale. The quantity sold in this way was 2,500 maunds in the district of Hissar and about 1,000 maunds in the district of Rohtak. In the district of Karnal no such arrangements were possible, but we were careful to see that the cultivators got a good premium as this is the only way to encourage them to take up its cultivation. We collected the cotton from different villages and railed it to Lyallpur where it was sold. This procedure was very arduous entailing a good deal of attention and effort, but this was amply repaid as the premium that came to the pocket of the cultivators after deducting all charges for bagging, railing, and marketting, etc., was over Rs. 6 per maund. This was greatly appreciated, and it helped to establish the reputation of this cotton in the district.

The area under American cotton in the district of Rohtak during the present season is reported to be 1,500 acres. Figures as to the area under American cotton in the district of Hissar and Karnal have not yet been received, but seed enough to sow 2,000 acres and 1,500 acres, respectively, has been distributed, besides the seed that the cultivators had kept for their own requirements. I may here, also, add that the districts of Hissar and Karnal do not present a very hopeful field for the American cotton. In the district of Hissar water is not available in the early season and cotton is chiefly sown in the stubble of the wheat and quite frequently after the burst and with the help of monsoon rains. There is again a deficiency of water in the months of September and October. In the district of Karnal cotton is considered a secondary crop, and sugarcane is given preference. Sugarcane sowings are continued till about the middle of May after which the cultivator directs his attention to the sowing of cotton and thus gets late for American cotton.

Neglectum White Flowered Bhatla Selected.—Owing to the above-mentioned reasons Desi cotton is naturally more suited for this part and the seed of Neglectum White Flowered Bhatla selected was in very great demand. The quantity of seed at our disposal being limited it has been distributed mainly within a radius of 5 miles of the Hansi Farm, so that it may be grown under proper supervision, and produce collected for ginning and obtaining pure seed. Eight bags of the seed of this cotton were sent to Ferozepore for trial at the special request of those cultivators of Ferozepore District who visited the Hansi Farm during Kharif, 1919.

Demonstration of Sowing Cotton in Lines.—I am giving below a list of the various demonstrations held to teach the cultivators the sowing of cotton in lines. As will be seen the number of villages in which such demonstrations were held are 14, 8, and 7 for the districts of Ferozepore, Rohtak and Hissar, respectively. As a result most of the area in the

Ferozepore District is reported to have been sown in lines; and this method is also being largely practised in the districts of Hissar and Rohtak.

Names of villages in which demonstration of sowing cotton in lines was given :—

Ferozepore District.	*Rohtak District.*	*Hissar District.*
Abohar.	Rohtak.	Reli.
Azimgarh.	Bohar.	Bahauddin.
Kundwala.	Madina.	Chakkan.
Diwankhera.	Bharain.	Bhatla.
Patrewala.	Farmana Khas.	Kharar.
Jandwala.	Kalanaur.	Khanda Kheri.
Dabwali.	Chari.	Narnaund.
Malke.	Matindu.	
Bagha.		
Bahana.		
Budhsingh-wala.		
Chak Gandasingh.		
Dala.		
Ranke Kalan.		

Wheat.—During the last season the area under our wheat types was doubled in the district of Ferozepore, while there were about 5,000 acres in the other districts. The area under Pusa-12 in the Panipat Tahsil is not included in this, and it is reported that this wheat now prevails in the neighbourhood of Panipat.

This year 3,700 maunds of wheat seed has been stored for distribution during the coming season. Out of this 1,500 maunds were purchased by the Department, and 2,200 maunds have been stored by private persons.

8-A was given a trial at various places in all the districts and is greatly liked by the growers. It is reported to have given very good yield and the grain is also large and hard. The bulk of the area during the present year was, however, under Pusa-12 and Punjab-11. Punjab-11 gives good yield, but is small in grain and therefore is not much liked by the growers. Pusa 12 ripens early, gives good yield, but sheds its grain very easily, therefore it is only liked for cultivation on well-irrigated lands with small holdings, where the growers can arrange for its harvesting at proper time, and these cultivate Pusa-12. On the other hand on canal-irrigated lands with large holdings the cultivators are giving up cultivation of Pusa-12, as they feel they suffer loss owing to shedding of grain.

Sugarcane.—In the district of Ferozepore, where thick cane is grown for chewing purpose, red rot has been doing great damage. An experiment was made to see if canes grown from healthy sets would be free from red rot. The canes obtained from good seed were sound, and the experiment is being continued during the present season.

A trial of Bihar, Yuba and Suretha, varieties was made in the Ferozepore District. All of these seem to have done well there. In the district of Karnal I am making this year a trial with Bihar and Yuba canes at two different places. The area of sugarcane being very considerable in this district as well as in the adjoining district of Rohtak, this experiment is of great economical value.

Rice.—Five varieties were obtained by me from the Deputy Director of Agriculture, Jubbulpore (C. P.), and were tried at three different places in the Ferozepore District. All these varieties are late, and the late water not being available these have given poor outturn.

Barley.—Four varieties were obtained from the Economic Botanist Punjab, and were grown side by side with local barley at three different places in the district of Gurgaon. Type No. 4 has done best and is also an early-ripening variety. The results at our Farm are also in favour of this type.

Miscellaneous Crops.—A trial of four varieties of gram obtained from the Economic Botanist, Punjab, was made. The results yet require further confirmation. Japan, sarson, Australian bajra, lucern and barseem were tried and were successfully grown at various places. Two varieties of castor were also tried, but these suffered from frost.

Introduction of improved Implements.—Owing to the heavy prices the introduction of improved implements was greatly hindered, and also on account of shipping difficulties implements were not obtainable when ordered by the cultivators. Consequently five chaff cutters ordered by cultivators of the Hissar District could not be supplied, being out of stock. The following is, however, a list of implements sold during the present year:—

Rajah Plough	11
Meston Plough	37
Spring Toothed Harrow	4
Horse Hoe	2
Cotton Hoe	1
Cotton Drill	1
Bar Harrows	6
Total	62

One hundred Meston ploughs ordered during the last year were actually received and sold during the year under report.

Demonstration of improved Implements.—Demonstrations of improved Agricultural implements were given at about 32 different places

reaper was worked at six different places. A list of demonstrations held during the year under report is given below :—

Village.	*District*	*Date.*
Rohtak ...	Rohtak ...	22nd July 1920.
Kalanaur ...	„ ...	14th July 1920.
Matindu ...	„ ...	23rd July 1920.
Bharain ...	„ ...	14th July 1920.
Madina ...	„ ...	21st July 1920.
Chari ...	„ ...	24th July 1920.
Jahaz Garh ...	„ ...	11th September 1919.
Dhanaur ...	„ ...	24th October 1919.
Charri ...	„ ...	11th December 1919.
Baland Pur ...	„ ...	18th July 1920.
Ahluana ...	„ ...	19th March 1920.
Beri ...	„ ...	24th April 1920.
Kharkhoda ...	„ ...	4th May 1920.
Butana ...	„ ...	29th June 1920.
Ahluana ...	„ ...	30th June 1920.
Makhu ...	Ferozepore ...	22nd January 1920.
Abohar ...	„ ...	25th March 1920.
Baghapurana ...	„ ...	10th May 1920.
Bohana ...	„ ...	17th May 1920.
Guruharsahai Chak Sherewala Jallalabad Tapa Puhla	„ ...	Demonstration of Rajah Reaper.
Narnaund ...	Hissar.	
Sisai ...	„	
Khanda Kheri ...	„	
Chang ...	„	
Bahauddin ...	„	
Chakkan ...	„	
Reli ...	„	
Pataudi ...	Pataudi State.	

Agricultural Associations.—Besides running the Agricultural Associations, Ferozepore and Hissar, two new Agricultural Associations were established during the year under report, namely the Agricultural Association, Rohtak and Karnal. These Associations hold out good promises of doing propaganda work.

Demonstration Farms and Plots.—The Rohtak Demonstration Farm during the very first year of its working has shown a considerable success in all directions. A regular cropping scheme was drawn up by me, and we had this year 10 acres of cotton, 7 acres of wheat, 8 acres of gram, and some area under fodder crops. The Farm after paying for labour and the pay of a Makaddam shows a net profit of Rs. 698-2-9. I may also add that on a private farm the pay of the

Rohtak Demonstration Farm.

Makaddam and the wages of the beldars which amount to Rs. 785-11-6 would also go to the pocket of the farmer, making a total income of Rs. 1,483-14-3. The labour and the Makaddam on a Government Farm represent the farmer's family on a private farm. It might be remembered that when this Farm was taken up a leading cultivator of the district remarked (زمین بیگھہ کی روٹی ہے) that this land was only capable of producing a loaf per bigha.

Canal water supply at this Farm is very deficient, otherwise still better results might have been possible.

A trial of growing American and Desi cotton, sowing cotton broadcast *versus* in lines, sowing of different varieties of wheat, a trial of different seed rates for wheat were done besides growing local jowar (Andropogon Sorghum), Australian and Desi bajra (Pennisetum typhoideum) and gowar (Cyamopsis Psoralioides). These proved very useful demonstrations for the cultivators of the district.

Jallalabad Demonstration Farm.—The Jallalabad Demonstration Farm was extended during the year under report and some new land at Chak Falahat for growing rice was added. Owing to the laying of this land and purchase of bullocks for Rs. 1,000 very little net profit is shown. Total income during the year was Rs. 6,406-4-6 against an expenditure of Rs. 6,316. The condition of the crops grown at this Farm was however good.

Guru Har Sahai Farm.—The Guru Har Sahai Farm has not done so well this year owing to the insufficient water supply from the tube well. It only shows a gross income of Rs. 3,074-8-0 against an expenditure of Rs. 2,067-11-10, giving a net income of Rs. 1,006-12-2.

Demonstration Plots.—The Demonstration plot at Bahauddin has been working successfully, and we had this year 54 acres of 8-A wheat, 55 acres of sugarcane, and 128 acres of cotton. All of the cottoon was sown in lines. The out-turns were satisfactory, and the demonstration plot is doing very useful work in the Sirsa Sub-Division.

Another demonstration plot at Relli has been started. It was intended to start quite a number of these demonstration plots, but this could not be done owing to the lack of staff. I have approached the Director of Agriculture to get sanction for four more Makaddams to carry out this work.

Lack of Staff.—There being a very limited number of Agricultural Assistants in this Circle, only one Agricultural Assistant was working in the districts of Hissar, Karnal, Gurgaon, and Ambala till November 1919. The Agricultural work in these districts being already in its initial stages very little progress could be expected with such small staff. I was given only two certified men during last year, and these are under training for the present. I can't hold any bright hopes till more men with good qualifications are available.

There has been no increase in the number of Deputy Director of Agriculture's office clerks since the start of this Circle. With the expansion of Agricultural activities and the field staff the load of work must increase, and one head clerk and a camp clerk who were considered sufficient in the beginning can by no means cope with the ever-increasing work of this office.

Training of Inspectors and Sub-Inspectors of Co-operative Credit Societies and Demonstration to Zamindars at the Farm.—All the Inspectors and Sub-Inspectors of Co-operative Credit Societies working in the districts of this circle were received in batches at the Hansi Farm, in consultation with the Registrar, Co-operative Credit Societies, and given a short course of lectures and practical training.

Parties of Revenue officers and cultivators of the districts of this circle were received and were shown the various experiments that are being conducted at the Farm and the implements were shown to them in working order.

CAMP MURREE:
The 31st July 1920.

DARSHAN SINGH,
Deputy Director of Agriculture, Hansi, Punjab.

INDEX.

A.

	PAGES.
Abohar. Cotton Auctions at—	23, 24, 44, 87
Administration of the Department. Controversy regarding—	34
Aeroplane—	
Photography Controversy regarding— ...	31
" Nature " on—	31
Agricultural—	
Assistants	2, 10, 17
Associations	27, 79, 84, 87, 91
„ on Cotton Auctions ...	45
Cattle	34, 35
Chemist—	
Annual Report, 1919-20	57-9
Bacteriological investigations by— ...	59
Green manuring experiments by— ...	59
Laboratory Investigations. Main directions of — by—	58
Provincial work of—	57
Soil Survey of—	57
Chemistry (Director of Agriculture's remarks)	6
College, Lyallpur	1, 2, 39-42
College. Endowments at —	41-2
Department—	
Reflections by Mr. S. M. Jacob ...	32
Budget allotment of—	33
Staff of—	1, 57, 61, 65, 73, 79, 85, 92, 93.
Development. Demonstration Farms as source of—	79
Education at Demonstration Farms ...	17, 79

A—CONTINUED.

	PAGES.
Agricultural—*contd.*—	
Engineer	2, 9, 27
„ Annual Report	73-8
Farms—	
Lyallpur	12, 13 also see Part II.
Gurdaspur	13, 14 Do.
Hansi	14-15 Do.
Sargodha	Do.
Implements	26, 27, 44, 47, 55
„ Demonstration of— ...	80, 81, 90, 91
„ Number of—sold during the year	26, 27, 44, 81, 90
Products—	
Analysis of—	57
„ „ fees for—	4
Workshops at Lyallpur	36, 75
Board—	
Provincial at Lyallpur	30
At Pusa	30, 31
Agriculture—	
Practical teaching of — on Demonstration Farms	17
Punjab. Pressing questions of— ...	34
Purposes. Colony grants for—... ...	29
Scientific—	7
Alkaline, Sulphates	7
American Cotton—	
At Lyallpur Agricultural Station ...	12, 22, 35
Area under—	44, 46, 47
„ „ in Canal Colonies	21
Effect of dryness on—	43, 44

A—CONTINUED.

	PAGES.
American Cotton—*concluded*—	
4-F in colonies	13
Failure of—	10, 35, 36, 37
Experiments. Results of—	68
Premium on—	22
Results of outturn	53 (Statement No. 3.)
Sirhind Canal in—...	44
Sowings in Colonies	21
„ on different dates. Results of— ...	53 (Staent No. 3.)
Watering experiments with—at Lyallpur ...	54 (State me n t No. 5.)
Waterings. Number of—for— ...	21
Yield. Fall in—	21
„ „ Problems raised by— ...	21
„ of—. The opinion of zemindars on—	21
Valuation of—in Bombay spot market ...	23
Amritsar Khalsa College. Demonstration Farm at—	17
Analysis –	
Of manures	4, 29, 57
Of Agricultural and Industrial products and soils. Fees for—	4
Aratship. Co-operative—at Lyallpur ...	45
Artificial manures. Demand for— ...	35
Assistants. Agricultural—	2, 10, 17, 46
Associations—	
Agricultural—	91 ,27, 84
Cotton-growing (British)—	30

A—CONCLUDED.

	PAGES.
Auctions of cotton	... 4, 23, 24, 44, 45, 84, 87
Agricultural Associations on— ...	... 45
Buyers at—	... 24
By Co-operative Department ...	... 23
Quantity sold at—... ...	... 84
System and advantages of—	... 4, 45, 84, 87
Australian Bajra	... 82, 90, 92

B.

Bacteriological Investigations ...	... 59
Baghdad Ashmoni cotton ...	... 22
Baha-ud-din. Cotton auction at— ...	... 24
Bahawalpur State. Tube wells for—	... 74
Bajra (Australian)	... 82, 90, 92
Baking tests of wheat	... 6
Bar Harrow	... 26, 27, 43, 44, 55, 81, 90
Bara Reclamation Experiments ...	... 6, 7, 57, 58
Barley	... 72, 90
„ Trial of—in Gurgaon District	... 72, 90
Barnes, Mr. Manurial Experiments by —	... 29
Barren land—	
Reclamation of. Laboratory work on—	... 58
In Montgomery—	... 57, 58
Bean fly	... 63
Beas Demonstration Farm ...	... 79, 80, 82
Berseem. Trial of—at Hansi ...	... 90
Bhalwal. Cotton auctions at— ...	... 24, 84
Bhusa-making plant	... 9, 74

B—CONCLUDED.

	PAGES.
Board of Agriculture at—	
Lyallpur	30
Pusa	30, 31
Boll-worm	9, 10, 61, 65
Parasite	10, 61, 63, 65
Bombay—	
Endowments to Punjab Agricultural College	42
Spot Cotton market	23
Market. Difference between Punjab Desi and Punjab American Cotton	43
Boring—	
Tube wells	9, 73
In wells	9, 73, 77, 78
Machine (power)	9, 74
Botanical area. Results of trials in the— ...	67, 72
Breeding Experiments of Entomologist ...	61
British Cotton-growing Association	30, 70
Budgets—	
Allotments of the Agricultural Department for ten years	33
Forecast of—for 5 years	34

C

Calcium sulphate	7
Canal colonies. American cotton in— ...	21, 43, 44, 46, 47 82, 83, 84
Canal(s)—	
Lining of—	7, 58
Seepage (direct) from—	58
Water. Demand of — in September and October.	22

C—CONTINUED.

	PAGES.
Cane—	
Coimbatore—at Gurdaspur Agricultural Station	14
Cultivation of—	16, 89, 90
Outturns of—	16
Castor. Trial of — at Hansi	90
Cattle, Agricultural	34, 35
Chaffcutter	44
Chalk	11
Chatta nooga Power Crushing Mill	14
Chillianwala Seed Farm...	17, 76, 79, 80
Circle, Lyallpur—	
Cotton work in—	44
District work in—	43
Wheat in—	43
Citrus diseases	62, 63, 65
Classes at the College	4, 39, 40
Clay soils and Soil Colloids	6, 8, 58
Coccons. Yield of — from eggs	64
Coimbatore cane	14
College. Agricultural —, Lyallpur	2, 3, 4, 36, 39, 42
Colony—	
Grants for agricultural purposes	29
Wheats	36
Comparative—	
Tests between Wheats 8 A and Punjab-11 ...	12, 16, 46, 52, 70, 71, 72, 82, 89
Results of — tests between early and late varieties of Toria	54 (Statement No. 4)
Tests of wheat types	52 (Statement No. 2).
Comparison between Wheats 8-A and Punjab-11.	50, 51
Zamindars' opinion on—	

C—CONTINUED.

	PAGES.
Co-operation of zamindars in Lower Bari Doab Colony	45
Co-operative—	
Aratship at Lyallpur	45
Cotton auctions	23, 45
Cotton	9, 10, 15, 19, 23, 30, 35, 37, 43, 47, 53, 61, 63, 65, 67, 68, 69, 70, 82, 83, 84, 87, 88, 90
Cotton—	
American	10, 12, 19, 21, 22, 35, 36, 37, 43, 44, 53, 68, 69, 82, 83, 87, 88.
Area under—	20, 44, 46, 82, 83, 87, 88.
„ „ 4-F	10, 22, 35, 36
„ „ „ Deterioration of— ...	21, 22
„ „ „ Failure of—	35, 37, 67, 83
„ „ „ Outturn. Results of— ...	35, 53 (Statement 3), 69.
„ „ „ Premiums on—	36, 69
„ „ „ In Mesopotamia	22
Sowings	20, 21, 44, 52, 83, 88.
Sowings on different dates. Results of— ...	53 (Statement 3).
In lines	43, 44, 45, 47, 79, 88.
Sowing. Time for—	46
White flowered. Bhatla selected— ...	15, 88
28 S. F.	13, 22, 43, 44, 68, 69, 70.
Desi	10, 15, 43, 82, 83, 88, 92.
„ Area under — in colonies	20, 82, 83

C—CONCLUDED.

	PAGES.
Cotton—*concluded.*	
Harrowing and Intercultu.e of crop ...	43
Auctions	23, 36, 44, 45, 79, 84, 87.
Bollworm	9, 10, 61, 63, 65
„ Parasite	61, 63, 65
Desi — Mollisoni	43
Effect of dryness on—	12, 43, 44
Effect of frost on—	84
Effect of rainfall on—	21
(Desi) experiments. Results of— ...	67
Growing Association, British	30, 72
At Hansi	15, 87, 88
Irrigation. Number of—	83
Pests	9, 10, 61, 63, 65
Seed	18, 45
„ Primium on—	44
„ Distribution of—	18, 45, 82, 87, 88
Valuation of—	15, 69, 70
Watering in May, June and July for— ...	43
Webber 49	22
Country Implements	44, 74
Course at Agricultural College	3, 4, 39, 40
Crop pests. Methods of cambating— ...	79
Crossings of wheat	72

D.

Dates. Purchase of — suckers	19
Dairy Farming grant	30
Deep-ploughing machine	7

D.—CONCLUDED.

	PAGES.
Demand of canal water in September and October	21, 22, 67, 83
Demonstration—	
Of implements	79, 80, 81, 82, 85, 90, 91.
,, at cattle fairs ...	81
Of sowing in lines	43, 79, 85
Farms	17, 79, 80, 91, 92
,, Expenditure and income from— ...	80, 91, 92
(Results)	84, 86, 92
Denitrification	8
Desi—	
Cotton	10, 15, 43, 82, 83, 88, 92.
,, Effects of dryness on—	43, 67, 88
,, Sowings	20
Determination of moisture	4, 58
Director of Agriculture, Punjab. Report of— ...	1-37
Diseases of stored potatoes	85
District—	
Agricultural work	17
Board Farms	17, 79, 80, 91, 92
Board Scholarships at Punjab Agricultural College.	41
Work in Lyallpur Circle	43-7
Work in Gurdaspur Circle	79-86
Work in Hansi Circle	87-93
Drainage	7, 58
Drills (implements)	27, 44, 74, 81, 90
Draught resisting grasses at Hansi	16
Dryness. Effect of — on cotton	21, 43, 44, 67, 83

E.

Earcockle of wheat	72
Economic Botany	4, 5, 6, 57-72

E—CONCLUDED.

	PAGES.
Economy (Rural) class in Agricultural College ...	40
Education, Agricultural	2-4, 17, 39-42, 80
Elevator (grain) at Lyallpur	28, 46
Endowments to Agricultural College ...	41
Engineer, Agricultural	2, 9, 27, 73-78
Engineering workshop	36, 75
Entomological publications	61
Entomologist, Government	1, 2, 9, 10, 11, 12, 61-5.
Entomology	61-5
Errors—	
Of estimation regarding wheat forecast estimates.	32
Experimental	9, 32
Euphalerus Citrii	61, 62
Evaporation losses	7, 22
Examinations of Agricultural College ...	3, 40, 42
Exhibitions, Agricultural	81
Expenditure of Agricultural Department ...	33
Experimental Farms	12-16, 36, 57
Experimental Error	9, 32
Experiments. Reports on—	4-16 and Expert's Reports.

F.

Farms—	
Demonstration	17, 76, 79, 80, 91, 92.
Experimental	12-16 and Part II
Seed	45, 79, 80, 82
Farming, intensive	35
Farmyard manure for cane	16
Fees for private analysis of soil, manures, etc. ...	9

F—CONCLUDED.

	PAGES.
Ferozepore District. Agricultural work in— ...	87-90
Fixation of Nitrogen	6-8,59
Fodders	16
Foddercutter...	27
Forecasts	31, 32
Accuracy of—	32, 34
Of wheat	32, 34
Foriegn Provinces. Students from—to the Punjab Agricultural College	2
Fowler, Steam tackle	7
Frost. Effect of—on cotton	84
Fruit farming grant	29
Fruit tree plantation (grant)	30
Fumigants	63
Fumigation	10, 63
Fungoid. Diseases of stored potatoes ...	85

G.

Ganjibar Experimental Station	57
Gazetted officers' estate at Lahore	30
Glossary of vernacular terms	at the end
Gojra. Cotton auctions at—	24
Grain Elevator at Lyallpur	28, 46
Grants for agricultural purposes in colonies ...	29, 30
Grasses	16
Green manuring	10, 11, 12, 58, 59, 80.
Groundnuts	82
Gujrat District —	
Agricultural work in—	74, 79, 80, 82, 84.
Green manuring at D. B. Farm— ...	76
Guara	2, 8

G—CONCLUDED.

PAGES.

Gur. The yields of—from sugarcane—
at Lyallpur Agricultural Station... ... 13
at Gurdaspur Agricultural Station ... 13
at Hansi Agricultural Station 16
Gurdaspur—
Agricultural Station... ... ... 10, 13, 14, 16, 39, 75, 79, also, Part II.
Wheat at— 14
Sugarcane at— 13
Manurial experiments at— 14
Gurdaspur Circle—
Agricultural work in— ... ... 1, 14, 18, 19, 79-86.
Wheat work in— 71, 82
Cotton work in— 83, 84
Gurgaon District. Trial of barley in— ... 90
Guru Har Sahai. Demonstration Farm— ... 92
Gypsum 7,58

H.

Hansi—
Agricultural Station ... ... 1, 14, 15, 16, 39, 90, 93.
Seed Depôt 22
Sugarcane at— 16
Wheat at— 15, 16, 20, 70, 90
Hansi Circle—
Agricultural work in— 18, 19, 87-92
Sugarcane in— 89, 90
Wheat. Trials of— 90
Harrowing of crops 43

H.—CONCLUDED.

	Pages.
Harrows—	
Bar	26, 27, 43, 44, 47, 55, 81, 90.
Spring tined	26, 27, 81, 90
Hill States. Sowing of wheat, Pusa 12, in—	19
Hissar. Agricultural work in—	88, 89
Hoes (implements)	26, 27, 44, 81, 90
Hoshiarpur—	
Agricultural work in—	17, 71, 79, 80
Farm	17, 80
Hydraulic tests at Lyallpur Agricultural Station.	12

I.

Implements	26, 27, 44, 47, 55, 74, 79, 80, 81, 90.
„ Demonstration of—	79, 80, 81, 82, 85, 90, 91.
„ Import of—	81
„ Price of—	27
„ Number sold during the year ...	26, 27, 55, 81, 90
„ On loan	81
„ Manufacture of—	27, 36, 44, 74
Income and expenditure of Demonstration Farms	80, 92
Industrial applications. Fees for analysis of— ...	4
Industrial Department	12
Industry, Silkworm	11
Insect. Attack on stored grains	3
Insect pests	10, 61, 65
Insecticides	63
Insectory	10, 61

I.—CONCLUDED.

	Pages.
Intensive farming	35
Interculture of cottons	43, 79
Inundation Canals, Imperial. Area under American Cotton—	83
Irrigation experiments...	12, 36, 43, 45, 54
„ „ Tube wells. Lease for— ...	30
Irrigation Experimental station	36

J.

Jacob, S. M., Mr.—	
Report of—	1-37
Experimental error-work on—	32
Forecast estimates of wheat	32, 34
Jalalabad Demonstration Farm	92
Jalalabad. Tube wells at—	74
Japan rape	82, 90
Jaranwala. Cotton auction at—	24, 45
Jhelum. Agricultural work in—	80
Jullundur. Agricultural work in—	20, 79, 82
Jullundur. Demonstration Farm—	17, 79, 80

K.

Kala Afghana. Seed godowns at—... ...	27, 75
Kala Shah Kaku. Tube-wells at—	30
Kallar. Appearance of—in Narwalla Farm ...	46
Karnal. Agricultural work in—	64, 88, 89, 90, 91
Khalsa College, Amritsar	17, 79, 90
Kot Kapura. Cotton auctions at—	23, 24, 44, 87

L.

Labour (manual). System of—at Agricultural College	42
Lahore. Gazetted Officers' estate in— ...	30

L.—CONCLUDED.

	Pages.
Lahore. Veterinary College	10
Lathyrus sativus	72
Leaf miners	63
Library of the Agricultural College ...	4, 61
Lift irrigation	73
Lining of canals	7, 58
Loan of implements	81
Lower Bari Doab Colony. Agricultural work in—	19, 21, 29, 45, 79.
Lower Chenab Canal. Agricultural work in— ...	19, 20, 22, 43, 79
Lower Jhelum Colony. Agricultural work in— ...	19, 81, 82, 83, 84
Lucern. Trial of—	90
Ludhiana. Agricultural work in—	17, 80
„ Farm	17
Lyallpur—	
Agricultural College	2, 4, 39, 42, 74
„ Station	6, 7, 12, 13, 14, 22, 32, 35, 52-4, 71, also part II, 16, 20, 46, 52.
Board of Agriculture	30
Agricultural Station. Watering experiments with cotton.	43, 54
Manurial experiments at—	29
Wheat trials	20, 46, 52
Circle cotton work	43
„ District work	18, 19, 20, 24, 28, 35, 43, 44, 45, 46, 47, 55, 72.
Wheats in—	43
Propaganda work	46

M.

Machine ploughing	7
Machinery Depôts	26, 27, 81

M—CONTINUED.

	Pages.
Maize	62, 79, 82
„ pests	62
Mango Hopper	10, 62, 63
Manufacture of implements	36, 43, 47
Manures	4, 14, 16, 29, 35
„ artificial. Demand for—	35
„ Fees for analysis of—	4
Manurial Experiments	14, 29
Marker (implements)	47
Marmalade-making grant	30
Mechanic Borer	73
Mechanical cultivation	35
Mesopotamia—	
Aeroplane Photography	31
„ „ Practical use in— ...	22
Cottons in—	22
Purchase of date suckers from— ...	19
Meston ploughs	27, 81, 90
Mian Chanu. Cotton auctions at— ...	24
Microbracon	61, 63
Mills—	
Delhi	6
Shahdara.	5
Cane crushing	13, 14
Milling and baking tests of wheats	4, 72
Moisture, soil	6
„ Equilibrium in the soil—. Statistics of— by Agricultural Chemist.	58
Mollisoni—Desi cotton	43, 67
Montgomery—	
Barren land in—. Reclamation of— ...	57, 58
Circle. Agricultural work in— ...	18, 20, 24, 43, 44, 46.
Cotton auctions at—	28, 47
Seed Farm	17, 45, 46

M—CONCLUDED.

	PAGES.
Moths on stored potatoe	85
Mukaddams	2, 17
Mulbery trees. Census of—	64
Mulberry trees. Plantation of—	64
Multan. Cotton sowings in—	20
Muzaffargarh	9, 74
Myllocerus Blandus	62

N.

Nahan — 3 Roller mill	14
Narwala Reh Farm	46
„ „ „ Cotton yield at— ...	46
„ „ „ Wheat yield at— ...	46
Native State and other Provinces—	
Admission from — to Punjab Agricultural College.	2, 40
Endowments from — to Punjab Agricultural College.	41, 42
Nitrifying organisms	7
Nitrogen Fixation	6, 7, 8, 59
Nitrogenous manures	29
North-West Frontier Province—	
Admission from — to Punjab Agricultural College.	40
Endowments from — to Punjab Agricultural College.	41

O.

Oat Hay Farm. Cotton crop at —	21
Okara. Cotton auctions at —	24
Olive Plantation and cultivation experiments in the Punjab	29
Olive oil	29

O—CONCLUDED.

	Pages.
Organisms, nitrifying	7
Osmatic pressure	6,58

P.

Panipat Tahsil. Area under wheat Pusa-12 ...	89
Parasites	10, 61, 63, 65
Parasites boxes	10, 61
Percolation of water from an irrigated field ...	58
Pests of—	
Cotton	10, 61, 63, 65
Maize	62
Sugarcane	62
Photography from æroplane	31
Phthirius Pubis	63
Phularwan. Cotton auctions at—	24,84
Ploughing competitions	81
Ploughs	26, 81, 90
Poisons. Use of — for weevils	14
Poona furnace for boiling sugarcane juice ...	29
Potato—	
Experiments	72, 85
Seed (improved). Demand of— ...	72
Storage experiments at Sialkot	85
Poultry	29
Power—	
Boring machine	9
Spraying machine	10
Pressure Osmatic	6
Propaganda work by the Agricultural Department	9, 27, 46
Provincial Board of Agriculture	30
Publications, Entomological	61
Punjab University	3

P—CONCLUDED.

	Pages.
Pusa—	
Board of Agriculture	30, 31
12 (wheat)	4, 5, 6, 15, 16, 19 35, 71, 82, 89.
„ in barani tracts	19, 82
„ in hills...	19
„ reasons for preference ...	89
„ disadvantage of sowing ...	23, 89

R.

Rainfall at—	
Gurdaspur Agricultural Station ...	13
Hansi Agricultural Station	15
Rats	63
Reapers	26, 44, 81
Rearing, silkworms	64
Reclamation of—	
Barren lands	5, 57, 58
Red rot on sugarcane	72, 89
Registrar, Co-operative Societies. Endowments to Agricultural College.	42
Reh Farm, Narwala	46
Renala Cotton crop at—	21
Report—	
By Agricultural Chemist	27-59
Of Agricultural College	39-42
Of Agricultural Engineer	73-8
Of Director of Agriculture	1-37
Of Economic Botanist	67-72
Of Entomologist to Government, Punjab ...	61-5
Professor of Agriculture	43-55
By Deputy Director of Agriculture, Gurdaspur,	79-86

R—CONCLUDED.

	Pages.
Report by Deputy Director of Agriculture, Hansi	87-93
Rice	4-90
Rohtak—	
Agricultural work in—	27, 65, 88, 91, 92
Sericulture in—	64
Demonstration Farm	91, 92

S.

Safflower	82
Salvation Army	11
San	7
Sargodha	10, 24, 62, 71, 76, 79, 81, 82, 84.
„ Cotton auctions at—	24, 84
Sarson (Japan)	82, 90
Scholarships—	
At the Agricultural College	4, 40, 41
District Board Agricultural College ...	41
For research	4
Seed—	
Allotment for—	19
Depôt accounts	18
Drills (implements)	27, 44, 47, 55, 74, 90.
Godowns for Co-operative Societies ...	17, 75
Farms	17, 45, 79, 80
Rate. Trials of wheat	92
Silkworm	11, 63, 64
Seepage—	
Direct from canals	58
Losses of canal water	22
Sericulture	10-12, 63-4

S—CONTINUED.

	PAGES.
Shahpur. Agricultural work in—	64, 79, 80
Sialkot—	
Agricultural work in—	71, 79, 82, 85
District. Wheat 8-A. Results of— ...	63
Farm	79, 80
Potato storage experiments at— ...	79, 85
Silkworm—	
Industry	11
Rearing	64
„ in schools	64
Seed reared. Quantity of—	64
Seed	11, 63, 64
„ Cost of—	11
„ Distribution of—	64
„ Yield from one ounce of —... ...	64
„ Yield from one ounce of — by schools ...	64
Simla—	
Barnes Court. Poultry show at— ...	29
Silk School	11
Sind. Admission to Agricultural College from—	40
Sirhind Canal. Cotton (American) in— ...	44
Soils—	
Analysis of — . Fees for—	4
Clay	8
Colloides	6, 58
Of Hansi Farm	16
Humidity of—	6
Moisture	6, 58
Of the Punjab	8

S—CONTINUED.

	PAGES.
Soils—*concld.*	
Survey of —	7, 57
Saturated. Equation determining the distribution of moisture in— ...	58
Soldiers' class	17
Southern, Mr., Memorial Fund	4
Sowing—	
Of cotton in lines	36, 43, 70, 88
Of cotton in lines on different dates ...	46, 53
Of maize in lines	79
Special students	2
Spraying—	
Experiments	62
Machine (power)	14
Staff—	
Of Agricultural Department	1, 57, 61, 65, 73 79, 85, 92, 93.
Of Agricultural Chemist	57
Of Deputy Director of Agriculture, Gurdaspur	79, 85
Of Agricultural Engineer	73
Of Entomologist	61, 65
Of Hansi Circle	92, 93
Steam Tackle, Fowlers	7
Stored grains. Insects' attack on— ...	63
Stores. Fumigation of—	63
Strainer pipes	73, 77
„ „ Details of — used in the Punjab ...	77
Sugarcane	13, 16, 62, 72, 82, 89, 90
At Gurdaspur Agricultural Station ...	13, 16
In Hansi Circle	89, 90

S—CONCLUDED.

	PAGES.
Sugarcane—*concld*—	
At Lyallpur	13, 16
Preference of — over cotton	88
Borer	62
Red Rot on—	72, 89
Sugarcane Juice boiling plant at Gurdaspur ...	75
Sugar Committee	13
Sullage experiments	6, 8, 59
Sulphate Alkaline	7
„ Calcium	7
Survey of soils	7, 57
Sutlej valley—Survey of soils	7
„ „ Time for sowing cotton in— ...	46
T	
Tata & Sons, Messrs	24, 70
Toria, early variety	46
„ „ „ Results of trials ...	54
„ Late variety	46
„ „ „ Results of trials	54
Tube wells	4, 9, 30, 73, 74, 92
„ „ Irrigation Experiments. Lease for ...	30
U	
University, Punjab	3
Upper Bari Doab Colony—	
Cotton sowings in—	20, 21
Experiments in rearing silkworm in huts in—	61
Upper Jhelum Colony. Cottons in—... ...	82
Upper Sutlej Inundation Canal. Cotton sowing in—	20
V	
Valuation—	
Of Cotton. Reports on—	69, 70

V—CONCLUDED.

	PAGES.
Valuation—*concld*—	
Of cotton 4-F	69
Of cotton 85-F	69
Of Punjab and American cottons in Bombay market	23, 43
Vapour pressure curve for water in soils ...	55
Varietal tests of wheats —	
At Lyallpur Agricultural Station ...	12, 50, 51, 52
At Hansi Agricultural Station ...	15, 16
Vernacular Course	4
Vernacular terms. Glossary of—	at the end
Veterinary College, Lahore	9, 73, 74
Visitors at the Agricultural Farms	14, 16, 46, 93
W	
Water-logging	7, 38
„ Requirements of—for cotton plants	21, 43, 67, 83
Waterings—	
Of cotton in May, June, and July ...	43
Experiments with cotton 4-F ...	45, 54 (Statement 5.)
Number of—for American Cotton ...	21
Weevil. Experiments against—	10, 63
Well-borers	73
Well-boring	9, 73
„ Object of—	73
„ Results of — by districts ...	73, 77
„ Supervisors	73
Wheat 8-A	5, 6, 12, 19, 20, 35, 45, 46, 50, 51, 52, 70, 71, 72, 82, 89.
„ „ at Gurdaspur Agricultural Station ...	14, 71
„ „ at Hansi	16, 17, 20, 70
„ „ at Lyallpur Agricultural Station ...	20, 45, 52, 71
„ „ in Lyallpur Circle	20, 45, 50, 51

W—CONTINUED.

	PAGES.
Wheat 8-A—*concld.*—	
Analysis of yields ...	... 12, 14, 15, 16, 19, 20, 35, 50, 51, 52, 71, 72, 82, 89.
And Punjab 11.—	
Zemindars' opinion on—	... 50, 51
Comparative tests of— ...	... 52
Comparasion between— ...	... 19, 20, 35, 45, 46, 52, 70, 71, 72, 82, 89.
Wheat Punjab 11	.. 5, 6, 19, 20, 35, 45, 46, 52, 70, 71, 72, 82, 89.
,, ,, Area under— ...	... 45, 89
,, ,, As a colony wheat ...	... 36
,, ,, At Hansi ...	... 15, 16 2
,, ,, At Lyallpur ...	... 12, 20
,, ,, Analysis of yields ...	... 12, 14-16, 19, 20, 35, 50-52, 70, 72, 82, 89.
,, ,, nd 8-A. Comparison between—	12, 15, 16, 19, 20, 35, 45, 52, 70, 71, 72, 82, 89.
,, ,, Zemindars' opinion on— ...	51
,, ,, Comparative tests of— ...	52
Wheat Pusa 12	4, 5, 6, 15, 16, 19, 35, 70, 82, 89.
,, ,, Disadvantages of sowing— ...	23, 89
,, ,, Reasons for preferring the well-irrigated land with small holdings ...	89
,, ,, In Barani tracts...	19
Wheats	4, 5, 6, 12, 14, 15, 16, 18, 19, 20, 32, 34, 35, 36, 45, 46, 50-51, 52, 63, 70, 71, 72, 82, 89.

W—CONCLUDED.

PAGES.

Wheats—*Concld*—

Bushal weight of— 5

Earcockle on— 72

Economic values of— 72

Forecast estimates of— 32, 34

At Narwala Reh Farm 45

At Lyallpur Agricultural Station ... 12

At Gurdaspur Agricultural Station ... 14

At Hansi Agricultural Station 15, 16

Milling and baking tests 4, 6, 72

Winter 12

Wheat seed—

Distribution of— ... ... 19, 36, 45, 71, 82, 89.

Of Agricultural Department. Premium on— 45

Profit and loss account from sale of ... 18

Farms 45, 82, 89

Wheat trials ... ... 12, 14, 15, 16, 19, 45, 50, 51, 52, 70, 71, 72, 92.

Winter wheat 12

Workshop. Engineering—at Lyallpur ... 27, 36, 75

Y

Yuba canes 90

Z

Zemindars' Co-operation in Lower Bari Doab Colony 45

Zamindars—

Opinion on cotton 21

„ „ wheat 45, 50, 51

Glossary of Vernacular terms (in Alphabetical order).

Vernacular.	English.	Botanical.
Acre ...	4,840 square yards.	
Alsi ...	Linseed ...	Linum usitatissimum.
Alu ...	Potato ...	Solanum tuberosum.
Arhar ...	Pigeon pea ...	Cajanus indicus.
Arú ...	Peach ...	Prunus persica.
Ata ...	Flour.	
Baguri ...	Hand hoe for hoeing sugarcane.	
Bajra ...	Bulrush Millet ...	Pennisetum typhoideum.
Banna ...	Field boundary.	
Bar ...	Hedge.	
Bara ...	A very hard type of alkaline soil in which the clay is in a deflocculated condition.	
Barani ...	Unirrigated (dependent on rainfall).	
Bari ...	Similar to Bara soil, but less hard.	
Basmati ...	Rice (a fine quality) ...	Oryza sativa.
Behar ...	A variety of medium thick sugarcane.	
Belna ...	Cane crushing or hand ginning machinery.	
Benola ...	Cotton seed.	
Berema ...	Do. ...	Gossypium.
Berseem ...	...	Trifolium Alexandrinum.
Bet ...	Country or land along a river.	
Bhakra ...	...	Tribulus terrestris.
Bhang ...	Indian Hemp ...	Cannabis sativa.
Bhâri ...	A bundle.	
Bhárola ...	Bin of mud for storing grains.	
Bhindi ...	Lady's finger ...	Hibiscus esculentus.
Bhusa ...	Wheat straw ...	Triticum vulgare.
Burli ...	A variety of thin sugarcane	
Chahi ...	Irrigated from wells.	
Chajh ...	A small indigenous winnower.	

Vernacular.	English.	Botanical.
Chamb ...	Lowlying land where water stagnates, water-logged land.	
Chana ...	Gram ...	Cicer arietinum.
Chappar ...	Pond.	
Chari ...	Sorghum (cultivated for fodder).	Andropogon sorghum.
Charsa ..	A leather bucket for lifting water.	
Chhattah ...	Broadcasting of seed.	
Chawal ...	Rice ...	Oryza sativa (husked).
Chhatak ..	5 tolas or 1/16th part of a seer of 80 tolas.	
Chhola ...	Gram ...	Cicer arietinum.
China ...	Common Millet ...	Panicum miliaceum.
Choha Ramba ...	A kind of digging implement.	
Desi ...	Country, Indigenous.	
Dhaura ...	A variety of thin cane.	
Dhingli ...	A kind of low water-lift.	
Dholú ...	A variety of thin cane—white coloured.	
Doda ...	Cotton boll.	
Dosanga ...	An implement to collect bhusa while threshing.	
Dranti ...	Sickle.	
Ganda ...	Onion ..	Allium Cepa.
Gandam ...	Wheat ...	Triticum vulgare.
Ganna ...	Thin sugarcane ...	Saccharum officinarum.
Ghamaon ...	8 kanals or 4,000 square yards. (In some districts equal to an acre.)	
Ghee ...	Clarified butter.	
Ghehun ...	Wheat ...	Triticum vulgare.
Ghun ...	Weevil.	
Gora Deh ..	Uncultivated land adjoining a village.	
Guara or Guar ...	...	Cyamopsis psoralioides.
Gur ...	Raw or unrefined sugar.	
Hal ...	Plough.	
Halas ...	Beam of the plough.	
Harir ...	Myrobalan ...	Terminalia Chebula.
Hathi ...	Handle of plough.	
Ikh ...	A variety of thin cane ...	Saccharum officinarum
Jal ...	Net.	
Jau ...	Barley	Hordeum vulgare.

Vernacular.	English.	Botanical.
Javi ...	Oats ...	Avena sativa.
Jhona ...	Unhusked rice ...	Oryza sativa.
Johar ...	Pond.	
Juar ...	Sorghum (culivated for grain.)	Andropogon sorghum.
Jula ...	Upper part of yoke.	
Káhi ..	Reed ...	Saccharum spontaneum.
Kahi ...	Spade.	
Kachnar ...	...	Bauhinia variegata.
Kalráthi ...	Hard alkaline soil.	
Kamad ...	Thin sugarcane ...	Saccharum officinarum.
Kanak ...	Wheat ...	Triticum vulgare.
Kanal ...	20 marlas or 500 square yards.	
Kangni ...	Italian millet ...	Setaria italica.
Kapas ...	Cotton with seed ..	Gossypium.
Karáh ...	Leveller.	
Karbi ...	Dry Maize, Sorghum or Bajra Stalks, stacked for fodder.	
Karsana ...	Winter, or fallow ploughing.	
Káshtkár ...	Cultivator.	
Kasumba ...	Safflower ...	Carthamus tinctorius.
Katha ...	A variety of thin cane.	
Kera ...	Dibbling seed in the furrow behind plough.	
Khajur (plant) ...	Date palm ...	Phœnix dactylifera.
Khajur (fruit) ...	Date ...	Ditto.
Khal ...	Water channel.	
Khapra ...	Weevil.	
Kharif ...	Monsoon or summer crop.	
Khurpa ...	See Ramba.	
Kikar ...	...	Acacia arabica.
Killa ...	=1/25th of a square.	
Kohlu ...	Oilseed crusher.	
Kor ...	First irrigation after sowing	
Kur ...	Sole of the plough.	
Lalri ...	A variety of thin cane.	
Lasan ...	Garlic ...	Allium sativa.
Lusan ...	Lucern ...	Medicago sativa.
Mahajans ...	Money-lenders.	
Maina ...	A kind of clover ...	Medicago denticulata.
Maira ...	Loamy soil.	
Makki ...	Maize ...	Zea Mays.

Vernacular.	English.	Botanical.
Makoh ...	...	Solanum nigrum.
Mandal ..	...	Eleusine coracana.
Mandi ...	Market.	
Marla ...	=9 sarsahis or 25 square yards.	
Masar ...	Lentil ...	Lens esculenta.
Mash ...	A kind of pulse ...	Phaseolus radiatus.
Maund ...	=82⅔ lbs.	
Moth ...	A kind of pulse ...	Phaseolus aconitifolius.
Mung ...	Ditto ...	Phaseolus Mungo.
Mungphali ...	Groundnut, Peanut, Monkey nut, Earthnut.	Arachis hypogoea.
Munna ...	A kind of local plough.	
Muruba ...	A square of land of 28 acres in Lower Chenab Colony.	
Do. ...	A rectangle of land of 25 acres in Lower Bari Doab Colony.	
Muzarah ...	Tenant.	
Nehar ...	Canal.	
Nehri ...	Canal irrigated.	
Niain ...	Cultivated land adjoining a village.	
Nil ...	Indigo ...	Indigofera tinctoria.
Paleva ...	Irrigation before sowing.	
Panjali ...	Yoke.	
Pathi ...	Sole of the plough.	
Pattal ...	A sort of net to cover threshed grain or threshing floor in case of heavy wind.	
Phálá ...	Share of a plough.	
Phâlâh ...	Thresher (indigenous).	
Piaz ...	Onion ...	Allium cepa.
Pir ...	Threshing floor.	
Pounda ...	Thick sugarcane	Saccharum officinarum.
Rabi ...	Winter crop.	
Ragi ...	A millet	Eleusine coracana.
Rahat ...	Persian wheel.	
Rai ...	Mustard ...	Brassica juncea.
Rajbaha ...	A big canal distributary.	
Ramba ...	A kind of indigenous hand hoe used for hoeing and cutting grass.	
Rasta ...	Path or road.	
Reh ...	Alkali-carbonates and sulphates.	

Vernacular.	English.	Botanical.
Retar ...	Sandy soil.	
Raoni ...	Irrigation before sowing.	
Rui ...	Cotton-lint.	
Sailab. ...	Moist soil or land liable to be flooded from a river or stream occasionally.	
Sila ...	Locust.	
Sankokra ...	Deccan Hemp ...	Hibiscus cannabinus.
Sannah ...	Front of the beam of plough.	
Santara ...	Orange ...	Citrus aurantium.
Sarsahi ...	2⅞th square yards.	
Sarson ...	Rape ...	Brassica campestris var. glauca.
Senji ...	Indian clover ...	Melilotus parviflora.
Ser ...	=80 tolas in weight or 1/40th of a maund.	
Shaftal ...	Kabli clover ...	Trifolium resupinatum.
Sohaga ...	A wooden plank leveller.	
Sundi ...	Larval stage of certain insects, caterpillar, maggot or grub.	
Suretha ...	A variety of thin cane.	
Susri ...	Weevil.	
Swank ...	A millet used both grain and fodder.	Panicum colonum.
Tamaku ..	Tobacco ...	Nicotiana tabacum.
Taramira ...	Rochet ..	Eruca sativa.
Tarangli ...	An implement for collecting Bhusa on threshing floor.	
Tela ...	Aphis or any sucking insect.	
Theeka ...	Big store made of sacks.	
Thom ...	Garlic ...	Allium sativa.
Tidla ...	Ground hopper.	
Tiddi ...	Locust.	
Til ...	Gingelly ...	Sesamum indicum.
Toba ...	Pond.	
Toria ...	An autumn mustard ...	Brassica campestris. Var. Toria.
Tut ...	Mulberry ...	Morus.
Usar ...	Alkaline salt.	
Wat ...	Field boundary.	
Yuba ...	A variety of medium thick cane.	
Zamindar ...	Agriculturist, farmer.	
Zamindari ...	Agricultural, pertaining to Agriculture, or farmer.	

PRINTED BY

THE SUPERINTENDENT GOVERNMENT PRINTING PUNJB.

26 DA—529—17-11-20—SGPP Lahore.

Report on the Operations of the Department of Agriculture, Punjab, for 1920-21.

Revised List of Agents for the sale of Punjab Government Publications.

IN THE UNITED KINGDOM.

CONSTABLE & Co., 10, Orange Street, Leicester Square, London, W.C.

KEGAN PAUL, TRENCH, TRÜBNER & Co., Limited, 68-74, Carter Lane, E.C., and 39, New Oxford Street, London, W.C.

BERNARD QUARITCH, 11, Grafton Street, New Bond Street, London, W.

T. FISHER UNWIN, Limited, No. 1, Adelphi Terrace, London, W.C.

P. S. KING & SON, 2 & 4, Great Smith Street, Westminster, London, S.W.

H. S. KING & Co., 65, Cornhill, and 9, Pall Mall, London.

GRINDLAY & Co., 54, Parliament Street, London, S.W.

W. THACKER & Co., 2, Creed Lane, London, E.C.

LUZAC & Co., 46, Great Russell Street, London, W.C.

B. H. BLACKWELL, 50 and 51, Broad Street, Oxford.

DEIGHTON BELL & Co., Limited, Cambridge.

OLIVER & BOYD, Tweeddale Court, Edinburgh.

E. PONSONBY, Limited, 116, Grafton Street, Dublin.

Messrs. WHELDON & WESLEY, Limited, 28, Essex Street, Strand, London.

ON THE CONTINENT.

ERNEST LEROUX, 28, Rue Bonaparte, PARIS, France.

MARTINUS NIJHOFF, The Hague Holland.

IN INDIA.

The Manager, Imperial Book Depôt, Delhi.

GULAB SINGH & SONS, Mufid-i-'Am Press, Lahore.

MANAGER, Punjab Law Book Depôt Anarkali Bazar, Lahore.

RAMA KRISHNA & SONS, Book-sellers and News Agents, Anarkali Street, Lahore.

HONORARY SECRETARY, Punjab Religious Book Society, Anarkali, Lahore.

M ABDUL AZIZ, Manager, The *Vakil* and Roze Bazar Electric Press, Amritsar.

L. LABHU RAM, Book-seller, Ludhiana.

N. B. MATHUR, Superintendent and Proprietor, Nazir Kanun Hind Press, Allahabad.

D. B. TARAPOREVALA, SONS & Co., Bombay.

THACKER SPINK & Co., Calcutta and Simla.

NEWMAN & Co., Calcutta.

R. CAMBRAY & Co., Calcutta.

THACKER & Co., Bombay.

HIGGINBOTHAMS, Limited, Madras.

F. FISHER, Unwin, Calcutta.

V. KALYANARAM IYER & Co., 189, Esplanade Row, Madras.

G. A. NATESAN & Co., Madras.

SUPERINTENDENT, American Baptist Mission Press, Rangoon.

A. H. WHEELR & Co., Allahabad.

REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB.

For the year ending 30th June 1921.

PART I.

LIBRARY
OF THE
BOMBAY
BRANCH
OF THE
ROYAL
ASIATIC

Lahore :

PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRINTING, PUNJAB.

1921.

TABLE OF CONTENTS.

Para.	Contents.	Page.
1	Preliminary	1
2	Staff	*ib.*
3	The Agricultural College... ...	2
4	Economic Botany	4
5	Agricultural Chemistry	6
6	Entomology	7
7	Sericulture	*ib.*
8	Agricultural Engineering... ...	8
9	Lyallpur Experimental Farms ...	9
10	Gurdaspur Experimental Farm ...	10
11	Hansi Experimental Farm ...	12
12	Seed and Demonstration Farms ...	*ib.*
13	Wheat	13
14	Cotton	14
15	Cotton auctions	16
16	Seed Depôts...	18
17	Chari seed...	19
18	Cultural provement—Sowing in lines...	*ib.*
19	Implements	20

Para.	Contents.	Page.
20	Agricultural Associations ...	22
21	Colony grants	*ib.*
22	Wheat elevator	*ib.*
23	Concluding reflections	23
	APPENDICES.	
Appendix I	Report of the Principal, Punjab Agricultural College.	i—vi
„ II	Report of the Economic Botanist to Government, Punjab.	vii—xi
„ III	Report of the Agricultural Chemist to Government, Punjab.	xii—xv
„ IV	Report of the Entomologist to Government, Punjab.	xvi—xix
„ V	Report of the Agricultural Engineer to Government, Punjab.	xxi—xxiii
	Statement A.—Well Boring ...	xxiv
	Statement B.—Details of strainers used in wells in the Punjab.	xxv
„ VI	Report of the Professor of Agriculture, Lyallpur, on district work.	xxvi—xxx
„ VII	Report of the Deputy Director of Agriculture, I Circle, Gurdaspur, on district work.	xxxi—xli
„ VIII	Report of the Deputy Director of Agriculture, II Circle, Hansi, on district work.	xlii—xlvii

No. 491—50-2,

FROM

E. R. ABBOTT, ESQ., I.C.S.,
Financial Commissioner (Development),
Secretary to Government, Punjab,

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA, DEPARTMENT OF REVENUE AND AGRICULTURE, DELHI.

Dated Lahore, the 29th November 1921.

(Ministry of Agriculture.)

SIR,

I AM directed to forward, for the information of the Government of India, the Annual Report on the operations of the Department of Agriculture in the Punjab for the year ending 30th June 1921, together with a copy of the remarks recorded thereon by the Punjab Government (Ministry of Agriculture).

I have the honour to be,

SIR,

Your most obedient servant,

E. R. ABBOTT,

Financial Commissioner (Development),
Secretary to Government, Punjab.

229 FC—516—18-12-21—SGPP Lahore.

Review on the Annual Report on the Department of Agriculture, Punjab, for the year ending 30th June 1921.

Proceedings of the Punjab Government (Ministry of Agriculture), No. 491—50-1, dated 29th November 1921.

READ—

Letter No 5011, dated 3rd November 1921, from the Director of Agriculture, Punjab, forwarding the Annual Report on the operations of the Department of Agriculture in the Punjab for the year ending 30th June 1921.

REMARKS—There was a slight decrease this year, from 268 to 228, in the number of applicants for admission to the Agricultural College at Lyallpur. The proportion of agriculturists, which has increased so remarkably in the last two or three years, was, however, well maintained and the Director of Agriculture was very favourably impressed with the good type of candidates seeking admission. Altogether 54 were admitted, of whom 45 were agriculturists. The record of work done is good. The Final Examination for the B. Sc. Agriculture was held at the College this year for the first time, and out of 11 who went in, 6 passed. In the F. Sc. (Agriculture) 17 passed out of 26, and 17 out of 23 obtained the Leaving Certificate. But the necessity for the devotion of a large part of the students' time to learning English and Elementary Science is, as Mr. Townsend remarks, a weak point in the curriculum and further particulars of the scheme which he adumbrates for limiting admission to candidates who have passed the Intermediate Examination in Science of the Punjab University and for the institution of Intermediate Colleges, will be awaited with interest. The Vernacular class, the Teachers' class and the Rural Economy class continued to do valuable work. The College is also to be congratulated on its sensible and level-headed behaviour, under the tactful guidance of the Principal and the staff, during the Non-co-operation agitation of the past winter.

2. Bearing as they do directly on the Agriculture of the Province the labours of the Economic Botanist are of particular interest. The evolution of improved types of wheat and cotton have already greatly added to the wealth of the Province. Finality can never be achieved and the

results of the past year show that better types of both staples than have hitherto been given out, are already available. Gram, oats, sugarcane and potatoes have not been neglected. In view of its value as a food crop an extension of the cultivation of the potato in the plains seems eminently desirable and the possibility of supplying good seed tubers, and of demonstration with this crop on the various farms should not be lost sight of.

The popularity of Arab date palms in the south-west of the Punjab is assured. The demand for young plants is keen. The value of the date to supplement the ordinary food supply was very marked during the autumn of 1921 in the western districts.

Little or no attention has as yet been paid to the improvement of the fodder crops of the Province. This is a subject which should be taken up without delay as there is reason to fear that much effort and considerable areas are wasted in the cultivation of inferior fodder crops.

3. In the Agricultural Chemist's Branch the routine work, though reduced since fees were authorised for work done for private persons, is still considerable and encroaches on the time available for research. Much valuable work was, however, undertaken.

The experiments with a view to the reclamation of the barren Bara soil in the Montgomery District are expected to extend over some years and are at present in their initial stages. So far the results are of a negative character, but there is no reason to fear that this intractable soil will not in the end yield the secret of its infertility to the importunities of the scientist.

4. The labours of the Entomologist are conducted largely in the laboratory and research has been diligently prosecuted. Travelling exhibitions, however popular, do little more than excite curiosity. Efforts should be made to demonstrate on private gardens the value of spraying as conducted during the year at Shalamar. The importance of freeing stored wheat from weevils can hardly be exaggerated and if, as stated by the Entomologist, superheating kills the insects without affecting the germinative capacity of the grain it might be possible to instal machines at some of the principal mandis in the Province.

The year was a most unfavourable one for sericulture, but the efforts of the department to develop this industry are not being relaxed. The Department of Industries is now responsible for further processes after the cocoon has been produced.

5. The account of the Agricultural Engineering section is disappointing. In a year of drought, however, the importance of securing an increased supply of water by borings in existing wells is intensified and it is satisfactory that, in spite of the difficulties referred to by the Agricultural Engineer, the number of successful borings secured was increased. In view of the frequently temporary success of borings it is of great importance that a cheap form of pipe and strainer may be evolved. It is to be hoped that some record of the experiments already made will be available, and that the importance of the subject is not lost sight of.

Little information appears to be available at present as to the commercial value of tube wells operated by mechanical power. In view of the large areas in the Province to which canal irrigation cannot be extended, the possibility of extending this form of irrigation is of great importance and a beginning might be made by ascertaining and collating results already achieved. The high price of materials undoubtedly hinders private effort, but valuable information would be derived from an experimental Government installation on which water rates would be charged. If eventually found to be successful this form of activity would appear to be a promising field for co-operative effort.

6. The sections of the report most interesting to the general public are those which deal with the methods by which the results of the labours of the scientists are brought home to the cultivators. It is probably true that the ignorance of the masses is, as stated by the Entomologist, appalling, but it is clear that cultivators are not slow to adopt improved seed recommended by the Department and the accounts of the few seed depôts exhibit a profit for the year though the Gurdaspur Depôt returned a loss on cotton seed transactions. Cultural improvements are being gradually introduced and improved implements are gaining in popularity. Propaganda as understood in other countries is inapplicable to a community almost wholly illiterate. Much propaganda work can be done through the agricultural associations. The system of demonstration plots also is a promising means

of propaganda as it is free from the criticism to which Government or District Board demonstration farms are open, that the methods employed are beyond the means of peasant cultivators. In particular, the cure for earcockle in wheat could be shown to cultivators on such plots.

The Punjab Government (Ministry of Agriculure) agrees that District Board demonstration farms are not a success owing partly to the inevitable divided control and to the want of sustained interest of members of District Boards in such farms. It is doubtful indeed whether such farms have much direct effect on the agriculture of a district as their sphere of influence must in any case be restricted.

7. The district work of the Department extends at present roughly to only about half of the Province, including the most progressive districts. The proposed Multan experimental farm is long overdue in a part of the country where the agriculture of the Province is at its poorest and where uphill work of the most patient description will be necessary to overcome the ignorance, apathy and conservatism of the cultivator.

8. The Government of India have not as yet agreed to give up the cavalry runs, and it is too early as yet to say whether it will be possible to add to the area at the disposal of the Department any part of these runs. An extension of the Lyallpur farm is no doubt desirable. Additional seed and demonstration farms are probably not required in the areas where the cavalry runs have been allotted; but it is possible that a farm run as a commercial venture like the Military farm at Okara on ordinary Zamindari lines with improved methods and implements, might afford useful information to the department and prove a valuable object lesson not only to the great landlords but also to the peasant cultivators themselves.

9. The Punjab Government (Ministry of Agriculture) is glad to find that the Director is in touch with the Superintendent of the Okara farm, and that the Agricultural and Co-operative Departments, the operations of which so largely interlace, are working in close co-ordination for the common good.

10. It was most unfortunate that the first complete working year of the Lyallpur wheat elevator should have been signalised by the practically total prohibition of export of wheat from India. A certain amount of wheat was

however passed through it for the Indian market, and it is satisfactory to learn that the quality was so good that it commanded a higher price than the best bazar wheat. Messrs. Clement Robson & Co. continued to work the elevator on behalf of Government.

11. The Agricultural Department suffers, and must for some time to come continue to suffer, from a paucity of staff, but something has been done to remedy matters by the addition of 12 new Agricultural Assistants during the year and the recent sanction of six additional Imperial Officers. The Department, however, maintained its high record of enthusiasm and achievement and is to be congratulated on the substantial progress made during the year. Mr. Townsend has now resumed his old connection with the Department as its Director and the Punjab Government (Ministry of Agriculture) is indebted to him for a comprehensive and stimulating report.

ORDER.—Ordered that a copy of these remarks be forwarded to the Director of Agriculture, Punjab, for information, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India, in the Department of Revenue and Agriculture.

By order of the Punjab Government
(Ministry of Agriculture).

E. R. ABBOTT,

Financial Commissioner (Development),

Secretary to Government, Punjab.

229 FC—576—14-12-21—SGPP Lahore.

No. 5011.

FROM

C. A. H. TOWNSEND, Esq., I.C.S.,

Director of Agriculture, Punjab,

To

THE JUNIOR SECRETARY TO THE FINANCIAL COMMISSIONERS, PUNJAB.

Dated Lahore, the 3rd November 1921.

SIR,

I HAVE the honour to forward herewith advance copies of Part I of the Annual Report of the Department of Agriculture for the year ending 30th June 1921.

I have the honour to be,

SIR,

Your most obedient servant,

C. A. H. TOWNSEND,

Director of Agriculture, Punjab.

229 FC—516—15-12-21—SGPP Lahore.

Report of the Department of Agriculture, Punjab. 1920-21.

Section I.

Preliminary.

With the inauguration of the Reforms Scheme last January Agriculture has become a "transferred" subject, and this is the first report of the Department under the control of the Ministry of Agriculture.

Staff.

2. After about two-and-a-half years' absence on deputation to various posts, I returned to the office of the Director of Agriculture in November 1920, relieving Mr. S. M. Jacob, who proceeded on long leave. In the spring of this year the Department suffered severely from the loss of Mr. Roberts, Professor of Agriculture, and Principal of the Agricultural College, who left Government service, to become manager of the British Cotton-Growing Association's farm at Khanewal, and from the appointment of Mr. Faulkner, Deputy Director of Agriculture, to be Director of Agriculture in Nigeria. Mr. Roberts' place as Principal has been taken by Mr. Milne, Economic Botanist, and as Professor of Agriculture by Mr. Stewart, a new recruit.

Mr. Milne was on leave to the end of February. Lala Jai Chand, Assistant Professor of Botany, officiated for him.

Mr. Faulkner's post remains vacant at present. Messrs Sultan Ali and Darshan Singh, Deputy Directors, continued to hold charge of their respective circles, Gurdaspur and Hansi. Mr. T. A. Miller Brownlie, Agricultural Engineer, was on leave throughout the year. Mr. McCormack acted for him.

The second newly appointed Deputy Director of Agriculture, Dr. P. E. Lander, joined on December 5th, and has been acting as Agricultural Chemist from March 18th, *vice* Mr. Wilsdon, who went on leave. This is appropriate as Dr. Lander is a Chemist and not an Agriculturist.

It is hoped that our efforts to retain Mr. Wilsdon at Lyallpur will be successful, and that he will not revert to the Educational Department, to which he really belongs.

Among Provincial Service officers two Assistant Professors, Sardar Sahib Kharak Singh and Lala Madan Mohan

Lal, have been on long leave for the greater part of the year. Both of them are engaged in higher study in Europe. It is hoped that the knowledge thus gained by them will be of benefit to the province.

Twelve new posts of Agricultural Assistants were sanctioned during the year : all were filled.

It is pleasant to note that the pay of all officers of the Department, except that of mukaddams, whose case is still under the consideration of Government, has been revised and improved during the year.

The Agricultural College.

3. The number of applications for admission to the Agricultural College continues to be far in excess of the number that can be admitted. The figures for the last five years are given below :—

Year.	Applications.			Admissions.		
	Agriculturists.	Non-agriculturists.	Total.	Agriculturists.	Non-agriculturists.	Total.
1917 ...	78	124	202	23	16	39
1918 ...	100	125	225	37	17	54
1919 ...	173	92	265	47	9	56
1920 ..	202	66	268	50	4	54
1921 ...	151	77	228	45	9	54

I attach no importance to the slight decrease in the number of students seeking admission to the college this year as compared with its predecessors. I was at Lyallpur when the Principal was selecting students for admission to the college last May, and was much impressed by the good type of lad seeking entrance to the college.

Steps are being taken to considerably increase the capacity of the college.

The University Degree Examination of B.Sc. Agri. was held this year for the first time. Six students passed out of eleven ; the failures were particularly in Chemistry. This result is not entirely satisfactory, though it is not below the University pass percentage of B.Sc. of the Science Faculty of this year, which was 52 per cent. I have taken the necessary

steps to do all in our power to have the weak points in our course which the external examiners brought to light in the examinations last spring put right in future.

The following statement gives the results of the college passing out examinations of last year. It has been since 1918 affiliated to the Punjab University :—

Year.	Class.	Number examined.	Number passed.	Agriculturists.	Non-agriculturists.	Total.
1914 ...	Three years' course ...	10	9	4	5	9
1915 ...	Ditto	14	14	6	8	14
1916 ...	Leaving certificate (two years' course).	19	19	7	12	19
1917 ..	Ditto	20	20	12		20
1918 ...	Ditto	34	34	26	8	34
	Four years' course ...	6	6	2	4	6
	Total for year ..	40	40	28	12	40
1919 ...	Leaving certificate ...	14	14	11	3	14
	Four years' course ...	4	4	3	1	4
	Total for year ...	18	18	14	4	18
1920 ...	Leaving certificate ...	18	15	13	2	15
	Four years' course ...	20	17	10	7	17
	Total for year ...	38	32	23	9	32
1921 ...	F. Sc. (Agriculture)...	26	17	13	4	17
	B. Sc. (Agriculture)...	11	6	4	2	6
	Leaving certificate ...	23	17	16	1	7
	Total for year ...	60	40	33	7	40

Proposals to sanction a second Assistant Professor in English, as well as an additional Assistant Professor for Agriculture and a few subordinate posts are, and have been for some time, under the consideration of Government. The present Assistant Professor of English, Mr. Jagadhar Guleri, teaches both English and Agricultural Economics. He is also supposed to do research work in the latter subject But he is single handed, and is much handicapped in his work : the teaching of English takes up so much of his

time that he can devote but little to Economics. Yet the value of a correct and sound knowledge of this subject, especially at the present stage of India's development, cannot be overstated.

Vernacular Course

There were 76 applications for admission to the Vernacular class at Lyallpur, of which 26 were admitted. The newly started similar class at Gurdaspur admitted 9 students.

In the Rural Economy class 22 students received instruction as against 18 last year. I observed that some of the Zilladars sent to this class by the Irrigation Department were too old and knew too little English to derive benefit from it. The matter is being brought to the notice of the department concerned.

The number in the Teachers' class remained unchanged. It is satisfactory to learn that teachers trained in the college are doing useful work. The former lecturer of the class, L. Lachhman Das, has been appointed Assistant Inspector in Agriculture, and proposals are under consideration to appoint an Imperial Officer to supervise and guide the teaching of agriculture in the ordinary schools of the province.

Non-co-operation.

Nine students left the college during the excitement caused by "Non-co-operation" in November 1920: of these two returned after a short absence, and a third has been recently readmitted, after due consideration. Events at Nankana Sahib last February caused even more excitement. But thanks to the tact of the Principal and staff, particularly of Lala Jai Chand, Assistant Professor of Botany and Superintendent of the hostel, and of Bhai Jagat Singh, Assistant Professor of Chemistry, the college remained open all the time, and nothing untoward happened.

In his report the Principal points out, and I am in entire agreement with him, that the provision of more residential quarters for the college staff is urgently called for. I trust it will soon be possible to find money for the purpose.

Section II.

Economic Botany.

4. In the absence of Mr. Milne the work in the botanical section was carried on for the greater part of the year under report by Lala Jai Chand. There is nothing of importance to report this year under the head

"milling and baking experiments," of which my predecessor wrote so interesting an account last year. A detailed account of the work will be found in part II.

Wheat and cottons, the most important crops of the province, continue to be the main but—not the only—items of botanical research. What is said on these crops by Mr. Milne in his report is of great interest. His new wheat 8-A has in nearly all tests, whether conducted by him or the Agricultural staff, maintained its superiority over all the other varieties under trial. There is now a considerable demand for this wheat among zemindars for sowing purposes, and it is being given out to them for extensive trials. The results will be carefully watched. It is not improbable that it may eventually supplant out present favourite wheat, Punjab 11. An interesting article on the comparative merits of both wheats by Mr. Faulkner, late Deputy Director of Agriculture, Lyallpur, appeared in the Agricultural Journal of India for September 1921. Work on the earcockle disease in wheat continues, and an illustrated pamphlet on the subject in English, Urdu and Gurmukhi is being distributed.

Cottons.—In the experiments with cottons noted by the Economic Botanist 285-F. has beaten 4-F. Of these cottons more is said later. Mention was made in last year's report of the success of these two varieties in Mesopotamia. I have received a further report from the Director of Agriculture of that country elucidating the results. He observes that the yields of the Punjab varieties 4-F. and 285-F. were extraordinarily high in 1918-19, but the average yield fell in 1920, owing to the land becoming exhausted.

Date palms.—About six thousand date palm suckers were imported during the year from Mesopotamia, of which 3,8.1 were distributed to zemindars and 1,859 kept for plantation on departmental farms. Owing to the disturbed conditions prevailing in Mesopotamia and shipping difficulties the suckers arrived late and many of them in bad condition. On the new date farm at Muzaffargarh nearly two acres have been planted with Arabian date trees. A tube well has been installed at a cost of Rs. 7,500: this is intended to irrigate the palms when the canal is not running and also to demonstrate the advantages of tube wells for short water lifts, for which there appears to be considerable

scope in the Muzaffargarh District. The demand for these date palms is much in excess of the supply: the success of this work is assured.

Potatoes.—Very useful work continues to be done by the Economic Botanist on grамme, oats, sugarcane and Scotch potatoes. Tubers of these are in great demand in the Simla hills, as I personally satisfied myself. The area now grown with them in these hills is estimated at between five and six hundred acres.

Agricultural Chemistry.

5. *Analysis of samples.*—171 samples of various kinds were analysed for other departments and private individuals, while 803 samples were analysed in connection with research work proceeding in the laboratory.

Bara Reclamation.—The experiments so far conducted have been designed mainly to ascertain what crops are the best suited for cultivation on *bara* land. In the kharif the chief crops grown were rice and *jowar*: both these had a fair germination, but the plants soon died except in the case of rice on a few plots, which had been treated with gypsum. These also died subsequently after attaining a height of 6 feet. *Moong, mash, chari* and a few other miscellaneous crops were also tried with gypsum, while sugarcane was tried without it. The experience so far gained indicates that the only crop that can be successfully grown is sugarcane. The Agricultural Chemist thinks that it is not only the most successful crop on *bara* soils, but it is also the most satisfactory crop for its reclamation. During the rabi fifty acres were put under experimental cultivation: half was cultivated by bullock power and half by machinery, and part of the land was treated with castor cake in conjunction with gypsum. The average outturn of wheat per acre on the "bullock" area was 31 seers, while on the area worked by machinery the average outturn was only 13 seers. The results are by no means remarkable, but it must be remembered that we are not yet out of even the initial stages of the work, and some years must elapse before any results of economic importance can be obtained. A full account is given in part II. I observe that last year my predecessor was doubtful as to the correctness of Mr. Wilsdon's view that the main effect of

gypsum in improving a soil such as *bara* is physical. From such an examination as I have been able to give the matter I agree with Mr. Wilsdon.

Green Manuring.—The results of the green manuring experiments are ready for publication in the form of a bulletin. The object of the experiments has been to determine the effect of green manuring (*a*) in retaining moisture, and (*b*) on the yield of the following crop. Green manuring has been found successful in both these respects. Detailed results will be found in part II of the report.

Nitrogen Fixation.—The rainfall was deficient throughout the province, especially during the period land remained fallow (May to October) : observations made show an average loss of nitrogen of 4·6 per cent. as compared with the results of 1919, when experiments showed a gain of 3·5 per cent. This was in the main, I imagine, due to the different amounts of rain that fell in each year, but the Agricultural Chemist remarks that it is at present too early to draw any definite conclusions as to the connection between nitrogen and rainfall.

Sullage Experiments.—Work was hampered on account of deficient water-supply and the lifting pump being out of order. Arrangements are being made to replace the old engine and repair the existing pump.

Entomology.

6. Mr. Afzal Hussain gives an interesting account of his itinerating entomological exhibits. It is a successful method of propaganda.

The most important item of research conducted by him is his work on the methods of protecting stored grain from weevils. The results obtained are not yet conclusive, but the work is being carried on systematically.

Citrus Psylla and Mango Hopper.—These two insect pests have been successfully tackled by spraying operations.

Sericulture.

7. One thousand, seven hundred and sixty-two ozs. of silk worm seed was distributed, as against 600 ozs. during 1920, and rearing has been started in eight new districts, while 359 new rearers were trained during the year under report. The following table

shows the work done by the Department during the last four years :—

Year.	Total silk worm seed imported and distributed.	Number of rearers.	Yield of dry cocoons per ounce of seed.	Average price realized per ounce of seed.	Price per maund of dry cocoons.	No. of districts in which sericulture was practised.
	Ozs.		Seers.	Rs. A. P.	Rs. A. P.	
1918 ...	506	165	6 to 20	20 9 4	120 to 190	8
1919 ...	472	296	½ to 5	3 5 4	190 to 200	9
1920 ...	600	301	6 to 17	32 5 7	227	12
1921 ...	1,762	359	2	9 3 0	211 8 0	15

Unfortunately, owing to the exceptionally unfavourable season, hatching during the year was not satisfactory : and the yield of cocoons was very poor. For the next season arrangements are being made to distribute 3,000 ozs. of eggs, and a comprehensive scheme has been referred to Government for the development of sericulture in the province. It was decided in the year under report to transfer the whole of sericulture to the Agricultural Department, the Department of Industries taking charge once the cocoon has been produced.

Agricultural Engineering.

8. Difficulties in transport and increase in the cost of material continued to affect the progress of work in the Agricultural Engineer's section. During the greater part of the year under report the permanent Agricultural Engineer, Mr. Miller Brownlie, was absent on leave.

Well-boring.—There is a welcome increase in the number of wells bored during the year under report, while the percentage of success is about the same as last year. This is a useful and popular line of work. Proposals are under consideration to increase the number of borers and supervising staff in order to meet the increasing demand.

Reference is made in Mr. Brownlie's report to Mr. McCormack's experimental work on a cheap form of bamboo pipe and strainer. If these prove successful, they will certainly be much cheaper to instal than the present metal pipes and strainers. I have asked Mr. McCormack to let me have a note on the subject.

Tube Wells.—Five tube wells were in progress last year. Of these, those at Jalalabad and Muzaffargarh have been completed and are working satisfactorily. Work on the remainder has been postponed for the reasons explained in the Agricultural Engineer's report. A new tube well at the Gujrat Demonstration Farm is being installed.

Much of the time of the Agricultural Engineer is at present taken by teaching, and he is therefore unable to devote the time and attention that is necessary to the proper conduct of his research, experimental and provincial work. With the addition of the post of a second Agricultural Engineer, which has recently been sanctioned, it should be possible to extend the sphere of his usefulness.

Now that prices of material are tending slightly downwards, I anticipate, in particular, considerable developments in tube wells. During, and ever since, the war, it was impossible to do much in this direction owing to the extremely high prices of material : indeed at intervals it was impossible to get pipes, etc., at any price. But the bad monsoons the province has suffered of late years, and the large tracts of country in the province to which it is impossible to extend canal irrigation, renders an active and enterprizing course of action by Government in this matter a necessity.

Section III.—Experimental Farms.

9. *Lyallpur Area*—614—acres.

Rainfall—June to Septr. 1920, 5·06.

„ Octr. 1920 to May 1921, ·16.

Full details will be found in part II of this report.

Mr. Roberts, Mr. Faulkner and Mr. Stewart were all in charge of the farm during the year, which, as the figures just given show, was one of the driest on record. Work continued as in previous year, sugarcane, wheat, cotton and *toria* being the main crops under trial, though some work was also done on mangels and flax. In addition to varietal tests on these crops, cultural, hydraulic and manurial experiments were also made.

As to sugarcane, *Suretha* seems the best variety, giving at least 11 maunds per acre more gur than the local variety *Katha*. Turning to wheats, we find many experiments

carried out between the rivals Punjab 11 (the variety we have been hitherto encouraging), and the Botanists' recent selection 8-A. It will be remembered that Mr. Milne says much as to the comparative merits of these wheats. The Lyallpur farm tests this year are on the whole very slightly in favour of Punjab 11. Tests in American cotton were principally made between 4-F. and 285.

Mr. Stewart says they may be interpreted by stating that on heavy lands with a plentiful supply of water the balance is in favour of 4-F., whilst on lighter soils, with a poor water supply, 285 does best. But, as was pointed out last year, it must be remembered that 285 cotton fetches, generally, maund for maund, a higher price than does 4-F. And this will, as Mr. Jacob said, probably compensate for the smaller yield, even if the latter is found to occur. In *toria*, Mr. Faulkner's selection, known as "early," is promising: early *raya* is particularly so.

In green manuring experiments, the past year has again demonstrated the superiority of the method of ploughing in the plant grown as manure, be it *gowara* or *san*, over that of applying, by artificials or otherwise, an equal amount of nitrogenous matter to the land, without the organic matter the *san* or *gowara* plant itself adds to it. This is doubtless due to the improvement effected in the physical conditions of the soil by the vegetative matter of the plant.

The farm has recently been equipped with two tractors and two self-driven threshing machines. Work with them will be noticed next year: they only arrived towards the conclusion of the year under report.

10. *Gurdaspur—Area*—161 acres.

Rainfall—June to Septr. 1920, 8·33.

„ Octr. 1920 to May 1921, 2·08.

This is primarily a sugarcane station, though other crops have been grown on it to an increasing extent of late years. This tendency will probably receive a check if the recommendations of the Sugar Committee, which are to the effect that cane should be restored to its position of importance on the farm, are given effect to.

As the figures just given show the year was very dry, the average annual rainfall of the district being 34·5 inches. Still, though the crop outturn figures on the farm

were not as high as in previous years, they were, the Deputy Director says, more than twice as high, on the average, as those which obtained in the district as a whole : and certainly a barani (rainfed) wheat crop of 861·6 lbs of grain per acre—over 10 maunds) in so dry a year, which the farm attained in one case—was a noteworthy achievement. The average barani crops in the district did not exceed half that figure.

Behar and Coimbatore 205 appear the best sugarcanes, but the Deputy Director wishes to try many tests for some time longer before pronouncing definitely on this important point. It is unfortunate that sugarcane produces seed nowhere in the north of India : for crossing, we have to get assistance from the Sugarcane Expert at Coimbatore in Madras, to whose assistance and advice generally we are much indebted.

Tests made with cane-crushers this year give slightly better results to the Chattanooga crusher as compared with the Nahan mill.

Ground nuts, maize, *til*, oats, *sarson* and *mash* are also being tried at the farm, but next to sugarcane the most important crop under trial there is wheat, both on barani and chahi land : as to this crop 8-A appears the best. The experiments designed to find a wheat that could be sown in December if the monsoon fails, and early Christmas rains fall, are very interesting, and should be continued.

The wooden bar harrow, admittedly successful in canal lands, must obviously be used with care in barani soils, to which its lack of adjustability makes it unsuitable. There appears some ground for thinking a "plough pan" exists on the farm. This is being further investigated.

The experiments with artificial manures confirm our experience elsewhere that, though these manures cause a greater outturn of crop, the increase in outturn is less than the cost of the manure.

A class for ex-soldiers in elementary agriculture has been in progress at the farm for some months. I saw it twice. It is a promising experiment, but in some cases the men selected for the class by the military authorities were not entirely suitable.

11. *Hansi—Area*—200 acres.

Rainfall—June to Septr. 1920, 5·35.

„ Octr. 1920 to May 1921, ·43.

The year was thus exceptionally dry, and the canal which irrigates most of the farm area ran very badly. This farm was started with the primary idea of improving the quality of the cotton grown in the surrounding country: and Sardar Darshan Singh's white-flowered Bhatla cotton, a local selection, continues, as last year, to be the best the Deputy Director has found. I do not think American cotton will ever be a great success in this tract. Of wheats, 8-A gave the best results.

The other experiments carried out on the farm, on these and other crops, in the year under report, do not call for remark, so abnormal was the season owing to the absence of moisture.

Section IV.—District Work.

Seed and demonstration farms.

12. I now give a very brief account of the methods by which the results attained on our experimental farms are brought home to the outside public, and of the extent to which that public is adopting them.

First come our seed and demonstration farms. These we have, under direct departmental management, at Sargodha, Montgomery and Chillianwala. Similar small farms, but financed by the District Boards concerned and managed partly by them and partly by us, are found at Gujrat, Sialkot, Raewind (Lahore District), Beas (Amritsar District), Jullundur, Ludhiana and Rohtak. Experience has shown me, at any rate, that it is much better for Government to run these farms itself, and proposals to take over, as a start, the Beas farm are under the consideration of Government. Other farms are found at the Khalsa College, Amritsar, and the Central Jail, Montgomery, and on the Jallalabad and Guru Harsahai Court of Wards' Estates in Ferozepore. All of these are, with wide variations, doing good work. The Narwala *reh* farm, mentioned by the Professor of Agriculture in his report on district work, is, as he says, really not under our management now. I think he exaggerates the

extent to which *kallar* has reappeared on it. I visited it recently, and found the amount of land reinfected with *kallar* very slight, much less than I anticipated.

The opening of similar demonstration farms by the Co operative Department and by private individuals, mentioned in the appendices on district work, is an interesting advance. The Co-operative Department has now one such small farm in the Lyallpur Colony and four in the Lower Bari Doab Colony. Of the private demonstration farms the most interesting is the Sardarpur farm, in the Lower Jhelum Colony, of which an account is given by the Deputy Director, Gurdaspur, in his report on district work.

At all these farms, those varieties of seed that we recommend are sown, and the various cultural and manurial methods that have been found successful at our experimental farms are practised.

Another method of advertisement that has been adopted particularly by the Deputy Director of Agriculture, Gurdaspur, at, I believe, the original suggestion of the Registrar, Co-operative Societies, is by demonstration plots. These are conducted in zemindars' land: the owner agrees to do every thing we recommend: whatever profit results is his. There were 30 of such plots in the Gurdaspur Circle this year, all of which gave a net increased yield of wheat alone, to the owner, of amounts varying between four maunds and nineteen seers per acre.

Wheat.

13. Of all crops grown in the province wheat is infinitely the most important: and to it the Agricultural Department has devoted, naturally, most attention from its inception.

As may be gathered from what has been said already in this report we have now among wheats two prominent competitors for our favour: the old established Punjab 11, and Mr. Milne's more recent selection 8-A. The former is still the wheat we encourage, particularly in the canal colonies, but from a careful examination of the many comparative tests made between these wheats and others all through the province I am inclined to think that 8-A will in a few years be our favourite wheat, at any rate in the eastern part of the province; but test must continue for some time yet. See in this connection paragraph 13 of last year's report. Both wheats are distinctly better yielders than the local varieties they replace.

Here are the figures of the sowings of Punjab 11 during each of the last four years :—

—	1917-18.	1918-19.	1919-20.	1920-21.
	Acres.	Acres.	Acres.	Acres.
Lower Chenab Colony ..	100,000	150,000	220,000	250,000
Lower Jhelum Colony ...	45,000	50,000	55,000	70,000
Lower Bari Doab Colony ..	50,000	100,000	100,000	311,000
Upper Chenab Colony ...	1,500	2,500	2,500	3,000
Total ...	196,500	302,500	377,500	634,000

Of course the Agricultural Department did not provide the seed for anything like all this area, though it did for a considerable portion of it. But practically all of it was grown under our advice.

8-A is grown, as yet, only by a few selected zamindars in the Lyallpur circle : in the Gurdaspur and Hansi circles the areas under it are reported to be 1,200 and 4,000 acres, respectively. In those circles Pusa 12 still continues the favourite ; in the Gurdaspur and Jullundur Districts alone some 16,000 acres are reported to be sown with that wheat. Its quality of early ripening stood it in particularly good stead in the hot winds of last spring.

Cotton.

14. The following are the figures of the sowings of American cotton in the Canal Colonies for the last three years :—

—	1919-20.	1920-21.	1921-22.
	Acres.	Acres.	Acres.
Lower Chenab Colony	226,693	273,261	196,562
Lower Bari Doab Colony	172,648	227,121	185,220
Upper Jhelum Colony ...	5,000	10,000	35,462
Lower Jhelum Colony	60,000	100,000	62,271
Other districts	50,000	95,000	45,000
Total ...	514,341	705,382	524,515

The present year shows, it will be seen, a considerable decrease in the area under this cotton, the area as compared with last year being about 74 per cent. But it is not difficult to find reasons for this. American cotton did not do very well in 1919 and 1920, particularly last year in the Lower Jhelum Colony, as explained in the annual reports relating to those years. Further, the great scarcity of fodder the province suffered from last winter has caused a larger area than usual to be placed under fodder crops, at the expense of cotton : the decrease in the area under *desi* cotton this year as compared with last is about 40 per cent.

Experience shows that the view held by Messrs. Milne and Roberts that American cotton generally needs better land, better water-supply and better cultivation than does country cotton, is correct : where those conditions are lacking it is wisest to sow *desi* cotton.

The Deputy Director, Hansi, was successful in getting some thousands of acres put under American cotton in the Ferozepore District in 1920. The crop did well, but the area under it there is very much less this year, as, owing to the absence of ginning factories in that district and the stoppage of goods traffic, which prevented the purchasers of the unginned cotton removing it by rail to their factories elsewhere for ginning, the premium on American cotton almost disappeared. I am taking up the question of erecting at least one ginning factory, as a commencement, in that district.

Nearly all this American cotton is 4-F. I confess I can find no real proof as to its deterioration, if grown under suitable conditions. A cotton merchant told me recently, not knowing who I was, that his firm had bought much 4-F. in the Punjab last year, and was very pleased with it. Cotton, generally, was of course much cheaper last year than in the year before, but even so our American cotton fetched a minimum premium of Rs. 2 per maund of unginned cotton, over *desi* cotton. Assuming the poor yield of five maunds per acre, we get a premium of at least rupees ten per acre sown, which sometimes amounted to much more.

Tests with 285-F. cotton are still continuing. Some 2,000 acres have been sown with it this year, in the canal colonies, with selected zemindars. If it does well this year, the question of replacing 4-F. by it generally must be seriously considered.

Nearly half the acreage of cotton in the province is now American : the latest figures are *desi* 635,250 acres, and American cotton 524,500, and it can be understood that the work involved in keeping these large areas of cotton (and also of wheat) grown by our advice comparatively pure, on the agricultural staff of all grades is very considerable.

As to *desi* cotton, the Deputy Director of Hansi, in whose circle that crop is, generally speaking, more important than is American cotton, sold about 1,000 maunds of his selected "Bhatla" white flowered variety. This should suffice to sow about 8,000 acres. He reports it as very popular. Its lint percentage is over 37 per cent. compared with 33 or 34 per cent. of the local variety : it is said also to be a heavier yielder.

Cotton auctions.

15. Twenty auctions were held in the year under report and 84,847 maunds of cotton were sold at them as agaist 53,512 maunds last year. The auctions have, I believe, to a large extent fulfilled their purpose in, at any rate, the older established markets. But in new or developing markets they undoubtedly serve a very useful function, and enable sellers to get more nearly the real price for their cotton than they would have otherwise.

Full details are given in the statement appended.

Statement showing sales of American Cotton at auctions held during 1920-21.

Place.	Date.	Quality A, pure 4-F.		Quality B, up to 1 per cent. desi in 4-F.		Quality C, up to 8 per cent. desi in 4-F.		Quality D, other American pure.		Quality E, other American up to 5 per cent. of desi.		Lots auctioned on samples.		Total sale.	Names of Chief Buyers.
		Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	Price per maund.	Weight in maunds.	
			Rs. A. P.		Rs. A. P.		Rs. A. P.		Rs. A. P.		Rs A. P.		Rs. A. P.		
1. Baha-ud-d'n	20-12-20	3,506	13 1 2	3,953	12 5 0	2,039	11 13 0	302	11 8 0	...	...	...	...	9,800	Volkart Bros. Co.
2. Sargodha ...	22-12-20	800	12 2 0	1,600	11 13 0	325	11 6 0	...	...	...	...	1,100	12 6 0	3,825	Dr. Kishen Singh, Lyallpur.
3. Malakwal ...	5-1-21	49	10 0 0	1,160	9 3 0	882	8 8 6	1,127	8 1 0	320	7 13 0	...	...	3,538	Lala Jawinda Mall, Ganesh Cotton Factory, Sargodha.
4. Bhalwal ...	7-1-21	140	10 9 0	450	10 5 0	320	9 14 0	440	9 2 0	...	...	...	...	1,350	Diwan Chand and Sardar Chanchel Singh.
5. Phularwan ...	12-1-21	45	12 2 0	740	11 6 0	390	11 4 0	330	10 14 6	...	...	...	...	1,505	
6. Sillanwali ...	13-1-21	120	12 0 0	816	11 10 0	411	11 4 0	195	10 6 0	...	...	...	...	1,542	Sardar Harbans Singh and Ghulab Singh,
7. Sargodha ...	9-2-21	1,743	10 15 0	1,322	10 8 0	152	9 12 0	...	...	...	...	...	...	3,217	Jaswant Rai Megh-Raj.
8. Baha-ud-din	12-2-21	561	10 0 0	750	9 7 0	650	9 5 0	123	9 1 0	...	...	...	...	2,084	Kesho Ram-Pokhar Das.
9. Montgomery	11-12-20	102	13 2 0	2,019	12 14 0	723	12 1 0	...	...	...	...	...	...	2,844	Rai Bahadur Narain Singh. Lala Wazir Chand.
10. Chichawatni	14-12-20	827	12 14 6	1,368	12 9 9	606	12 2 3	...	...	...	...	...	...	2,801	Amir Chand Jawala Das. Ramji Lal, Trikha Ram, Mathra Das, Thakar Das.
11. Lyallpur ...	13-12-20	693	14 12 6	798	13 12 0	81	13 12 0	...	...	...	...	...	...	1,772	Kirpa Ram, Brij Lal Sukhdeo Bux, Multani Chand.
12. Gojra ...	15-1-21	368	11 6 6	372	11 5 0	238	11 4 0	...	...	...	...	...	...	978	Dhanpat Mal Diwan Chand.
13. Jaranwala...	21-1-21	1,147	12 3 6	4,248	11 14 0	793	11 13 0	701	11 13 0	1,746	11 6 0	...	...	8,635	Messrs. Forbes, Forbes, Campbell & Co.
14. Nankana Sahib.	25-1-21	155	12 5 0	...	...	...	...	...	...	...	...	...	...	155	Seth Baldeo Sahai-Maya Das.
15. Toba Tek Singh.	27-1-21	173	10 12 3	377	10 5 6	191	9 15 6	...	...	...	...	...	...	741	Sheikh Muhammad Ismail. Dari Ram-Bishen Das.
16. Lyallpur ...	7-2-21	2,672	12 4 0	3,006	10 12 0	464	11 0 0	27	11 4 0	701	12 3 4	...	...	6,870	Kbushi Ram, Behari Lal.
17. Gojra ...	16-2-21	396	10 6 0	308	10 3 0	...	...	...	...	...	...	...	...	704	Ram Rattan Das of Okara
18. Abohar ...	8-1-21	4,532	10 1 9	4,250	9 10 0	2,424	9 0 0	...	...	...	...	...	...	11,206	Suchet Singh of Moga. Bansi Das-Jagat Ram.
19. Moga ...	8-1-21	1,027	10 10 0	71	9 8 0	...	...	...	...	...	...	...	...	1,098	Narain Mal Durga Das. Bajring Das Kalu Ram.
20. Kot Kapura	1-2-21	11,817	9 4 8	6,137	8 8 8	1,835	8 2 0	336	8 2 0	...	...	...	...	20,182	
													Total ...	94,847	

We continue to telegraph the Bombay and Lyallpur prices of cotton daily to the more important cotton markets in the canal colonies, where they are prominently displayed. In, at any rate, newly developing markets where there are only one or two ginning factories, and but little competition, this measure helps sellers of cotton to get more nearly the true price of their cotton than would have been the case otherwise.

16. *Seed Depôts.*—The profit and loss account of the seed depôts of wheat and cotton seed is as follows :—

Profit and Loss account of Wheat Seed Depôts for the year ending 31st *March* 1921.

Name of depôt.	Quantity purchased.	Purchase money, including other charges.	Sale money.	Profit or Loss.	Remarks.
1	2	3	4	5	6
	Mds. Srs. Chs.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Hansi Depôt ...	1,835 15 2	10,634 14 7	11,950 8 6	1,315 4 11	Profit.
Lyallpur Depôt ...	4,365 16 8	28,464 10 3	29,402 10 9	933 0 6	Do.
Montgomery Depôt	8,580 0 0	45,847 1 0	48,055 8 0	2,208 2 0	Do.
Gurdaspur Depôt...	4,842 29 10	35,368 8 3	36,135 11 11	767 3 8	Do.
Total ...	19,623 21 4	1,20,315 2 1	12,543 13 2	3,228 11 1	Profit.

Note.—Value of stock in hand on 31st March 1921 has been added to sale money.

Profit and Loss account of Cotton Seed Depôts for the year ending 31*st March* 1921.

Name of Depôt.	Quantity purchased.	Purchase money, including other charges.	Sale money.	Profit or Loss.	Remarks.
1	2	3	4	5	6
	Mds. Srs. Chs.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Hansi Depôt ...	825 0 0 1,502 24 5*	36,447 11 3	36,745 13 6	293 2 3	Profit.
Lyallpur Depôt ...	14,783 28 2	85,315 8 9	87,133 4 0	1,817 11 3	Do.
Montgomery Depôt	19,643 20 0	1,01,025 11 0	1,02,902 14 6	1,877 3 6	Do.
Gurdaspur Depôt	13,524 0 0	72,884 12 8	68,705 3 5	4,179 9 3	Loss.
Total ...	50,368 32 7	2,95,673 11 8	2,95,487 3 5	186 8 3	Loss.

Note.—Value of stock in hand on 31st March 1921 has been added to sale money.
*Cotton.

The allotments made this year were—

		Rs.
Deputy Director of Agriculture, Hansi, for purchase of cotton, wheat and lucerne seed	...	1,00,000
Deputy Director of Agriculture, Gurdaspur, for cotton, wheat and chari seed	...	98,000
Professor of Agriculture for cotton and wheat seed for—		
Lower Chenab Colony	...	1,40,000
Lower Bari Doab Colony	...	1,35,000
Economic Botanist	...	13,427
Miscellaneous,	...	439
Total	...	4,86,866

The corresponding figures given in paragraph 12 of last year's annual report were, I find incorrect. The wheat seed transactions of 1919-20 showed a profit of Rs. 344 : the cotton seed transactions a profit of Rs. 20,451.

Government has in India, as has been said before, to do business which in Europe is carried out by seed merchants. The money is returned with a profit, and is certainly well spent.

Chari seed.

17. The *chari* seed referred to in paragraph 16 of last year's report has been finally cleared. This spring, as there was again a keen demand for this seed, I placed about Rs. 17,000 at the disposal of the Deputy Director of Agriculture, Gurdaspur, for its purchase. M. Fateh-ud-din, Extra Assistant Director of Agriculture, purchased the seed, principally in the south-west of the Province and Sind. We were able to retail it at about Rs. 8 per maund in the central districts of the Punjab. The demand was very keen, and the effect on the price banias were charging, of between Rs. 13 and Rs. 14 per maund, very salutary.

Cultural improvements.
Sowing in lines.

18. Demonstrations of sowing cotton in lines and subsequent interculture, the most important of the many cultural improvements we advocate, were held by the Deputy Director of Agriculture, Hansi, in thirty villages in his circle, and

in other circles this branch of work continues to make considerable progress. A large area is now sown in lines in the Lower Chenab and Lower Bari Doab colonies, of which it has not been possible to frame an estimate : it runs to many thousands of acres, while the Deputy Director of Agriculture, Gurdaspur, says that over 12,000 acres of good crops sown in lines are standing in Lower Jhelum Colony. Generally wheat, cotton and maize are sown in lines in the non-colony districts where holdings are small, and work in this direction is concentrated mainly in the new colonies, where sowing of these crops by the broadcast method is usual, where fields are regular in shape, and labour saving implements can be usefully employed.

Implements.

19. The following statement gives details of the imported implements sold during the year under report, and in its three predecessors :—

Name of implements.	1917-18.	1918-19.	1919-20.	1920-21.
Raja ploughs	63	123	228	166
Meston ploughs	557	153	76	548
Other ploughs	41	9	4	5
Raja reapers	10	...	8	5
Hoes	30	13	8	8
Harrows	11	12	54	21
Fodder-cutters	13	80	50	148 82
Miscellaneous	...	6	4	11
Total ...	725	396	432	944

The above figures do not include 911 ploughshares which were also sold this year. The above data show that in spite of increasing prices which have during the past three years greatly affected sales generally, we seem to have turned the corner, and some of the implements, at any rate, particularly the cheap Meston ploughs, are now in great demand.

But is it not sufficient for a man to buy, say a Rajah plough: he has to be taught how and when to use it: and much of the time of the district staff is taken up in doing this. I am paying particular attention to this important matter.

The Professor of Agriculture remarks that no sooner does a consignment of Raja Fodder-cutters arrive than all are sold.

Country-made Implements.—The figures under this head are as follows:—

Name of implements.	Lyallpur.			Gurdaspur.			Hansi.		
	1918-19.	1919-20.	1920-21.	1918-19.	1919-20.	1920-21.	1918-19.	1919-20.	1920-21.
Bar harrows ...	293	341	438	37	85	70	...	6	5
Drills	100	181	116	6	5	25	19	1	...
Lyallpur hoes ...	86	79	39	10	...	...	...	...	...
Total ...	479	601	593	53	90	95	19	7	5

Aggregate,	1918-19	551
„	1919-20	698
„	1920-21	693

Of these implements bar harrows and drills are growing in popularity at Lyallpur. Some are now sold through the Co-operative Department. Mention must be made of the practical classes held at Lyallpur to train zemindars in the use of these implements. The Professor of Agriculture notes that the men trained at these classes are making use of the knowledge thus gained in their own villages.

Tractors. As the result of advertisements by several firms and demonstrations held in several places, much interest has of late been evinced in tractors. A few large landowners have bought different types; and it is reported that there are, in addition to the two tractors we are trying at Lyallpur, 4 tractors at work in the province. It is believed that they are being found useful for barani cultivation, but whether tractors will ultimately prove successful in the province, is more than any one can say at present. I personally think

that prospects for them are far from certain. The results obtained with the two working at Lyalipur are not yet sufficiently advanced, nor indeed is an experimental farm, with its small plots under various experiments, an ideal place to try them.

Agricultural Associations.

20. Agricultural Associations continued to hold their usual-half yearly meetings. They exist in practically every district in which we are working. It is satisfactory to note that meetings are better attended and members take generally more intelligent interest than used to be the case.

Colony grants.

21. The position as regards these grants is generally the same as described in paragraph 22 of last years report. Mr. Ganda Singh Cheema, the lessee of the fruit grant, has returned from America, but has not yet started work. This matter will be referred to more appropriately in next year's report.

Bhai Datar Singh has taken possession of his dairy grant and is doing fairly well.

Generally speaking, however, I am not in favour of making any more such grants in future, save perhaps grants designed to increase and store the amounts of pure wheat and cotton seed we require. My experience is that most lessees make many promises, but their principal object in practice, whatever the terms of the grant and whatever they have promised, is to grow wheat and cotton and make as much money for themselves in the shortest time as possible. I am, so far as is reasonably possible, insisting on the existing grantees complying with the terms of their grants.

Section V.

General.

Wheat Elevator.

22. The Wheat Elevator at Lyallpur, to which reference was made in paragraph 19 of last year's report, was worked during the year by Messrs Clements Robson and Company for Government.

The year was a most unfortunate one for the initial stages of such a venture. It is considered that elevator wheat can really only get its full value when placed in considerable quantities, of say 20 to 30 thousand tons, on the English market. But during the first part of the year no export of wheat overseas from India was allowed; during the second part export was allowed, but only on a very limited scale and subject to strict conditions. It was, in these circumstances, impossible to export any elevator wheat overseas. But it must not be inferred from this that the elevator lay empty through the year. Nearly 2,000 tons of wheat was passed through it by wheat dealers in the year: it was in the main purchased by mills in India, and generally realized, so level was its condition, and so clean the grain, from three to four annas per maund more than the best *bazar* wheat. And reports received from England on small samples of the wheat sent there lead to the conclusion that it is not unreasonable to expect a somewhat similar premium on elevator wheat, when sent to that country in sufficient quantities.

Proposals have been submitted to Government to continue the experiment on similar lines for three years more; it would be a thousand pities if the elevator was abandoned as a failure before it was given a full trial. Messrs Clements Robson and Company have done their part of the work admirably.

Concluding reflections.

23. I add a few reflections which occur to me after reviewing the year's work.

The first is the paucity of staff, especially for district work. Although the Agricultural Department has, I think, done useful work in, roughly speaking, that half of the province to which its activities extend, particularly in the canal colonies, and into the pockets of the residents of which it has, during the last few years, put many lakhs of rupees, mainly from its improved cotton and wheat, and whose confidence it is daily gaining to an increasing extent, yet the other half of the province practically remains untouched by it. It is true that it is hoped to make a start next year with the large Multan experimental farm, a site for which was selected some time ago: and the Secretary of State has recently sanctioned an addition of six Imperial

Officers to our cadre. This is all to the good. But for these officers and for this new farm and the other similar farms, that must follow it, to be of their maximum value to the province a considerable additional expenditure of money on subordinate staff, buildings and the like will be necessary. It is hoped that Government and the Legislative Council, which has the power of the purse, will take no niggardly view of its responsibilities in this matter. I must admit that I have seen no inclination on the part of the Council to be stingy to the Agricultural Department : and for that I am duly grateful.

Whatever the merits of the new system of administration, expedition in the disposal of proposals is not, I think, one of them. In November 1920 my predecessor asked for sanction to a much-needed increase in the staff of the Agricultural College : last May I asked for sanction to an also much-needed increase of 12 Agricultural Assistants for district work. Orders on both proposals are still awaited.

The Agricultural College is doing good work. But I do not think we have yet found finality in our curriculum ; our present degree, or main course, takes entrance-passed students for a four years' course in English. But experience has shown, so deficient is the general knowledge, particularly of English, of these students, when they enter the college, that much of their time, during at any rate their first two years there, is taken up with learning English and *elementary* Science, subjects which should really have no place in an Agricultural College. I have frequently discussed the subject with the teaching staff there, and with Mr. Anderson, Director of Public Instruction, to whose constant advice and kindness I am much indebted. I am inclined to think that the eventual solution may be to take students only when they have passed the Intermediate examination in science of the Punjab University, as is, I understand, the practice at the Medical College. A three years' course at the Agricultural College would probably then fit them for the degree in Agriculture. To make this scheme work properly, it may be necessary to institute Intermediate Colleges, as was recommended by the Calcutta University Commission, which would specialize in training students especially for the Agricultural College : the recently instituted colleges

at Multan and Ludhiana, and the Khalsa College at Amritsar appear to me particularly suited to this.

I recently asked Government to place at the disposal of the Agricultural Department some of the Cavalry runs, which are not now required, it is understood, for the purposes for which they were originally given. They would be most useful for—

(1) much-needed extensions to the Lyallpur farm area, and

(2) seed and demonstration farms.

Insufficiency of land and staff has, in particular, prevented us from yet taking up the improvement of the fodder supply of the province yet that problem is daily increasing in importance and should be attacked as soon as possible. Should we be fortunate enough to obtain any of the runs mentioned, we will be able to do so much earlier than appears otherwise probable.

Finally I must thank all the staff for good work during the year. Of enthusiastic co-operators with the Department who do not belong to it, I would make special mention of Mr. Flowerdew, Superintendent of the Military Oat Hay Farm at Okara. The officers of the Co-operative Department, as usual, continue to help us in every way they can.

C. A. H. TOWNSEND,

September 1921. *Director of Agriculture, Punjab.*

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

APPENDIX I.

Annual Report of the Principal, Punjab Agricultural College, Lyallpur, for the year 1920-21.

Staff.—On February 26th, 1921, shortly after I returned from home leave, the Principalship of the Agricultural College was handed over to me by Mr. W. Roberts, who left the service to become Manager of the British Cotton Growing Association farm at Khanewal. On return from leave I took up my position as Professor of Botany and Lala Jai Chand, who was acting for me, reverted to his permanent post of Assistant Professor of Botany. Chaudhri Ali Muhammad, who acted as Assistant Professor of Botany, reverted to his permanent position as Agricultural Assistant to the Economic Botanist. Lala Khushi Ram joined the section on 2nd May 1921 as Demonstrator in Botany.

When Mr. Roberts left the Department his position as Professor of Agriculture was taken over by Mr. Faulkner, who had been doing the work of Associate Professor of Agriculture, for some years back. On 11th April 1921 Mr. Faulkner left the service to become Director or Agriculture in Nigeria. Mr. Stewart, who joined the Agricultural Department, Punjab, as Deputy Director of Agriculture on 5th December 1920 and was under training at Lyallpur, was appointed Professor of Agriculture, *vice* Mr. Faulkner.

Mr. Wilsdon, Professor of Chemistry, went home on combined leave on 17th March 1921 and his place was taken by Dr. Lander who had joined the Department on 5th December 1920 and was at Lyallpur as a Deputy Director of Agriculture under training.

Sardar Sahib Kharak Singh, Assistant Professor of Agriculture, wen to England on 18th September 1920 for further study, and Lala Madan Mohan Lal, Assistant Professor of Entomology, also went to England and France for the same purpose on 14th August 1920

Bhai Labh Singh, Agricultural Assistant, is acting for Sardar Sahib Kharak Singh and Bhai Hem Singh, Demonstrator in the Entomological Section, is acting for Lala Madan Mohan Lal.

A new post of Assistant Inspector of Agriculture for the inspection of agriculture now taught in rural schools in the Province, has been created by the Educational Department, and Lala Lachhman Das, Senior Lecturer to the class of Middle School Teachers, sent here for agricultural training, has been appointed to the post. M. Ghulam Muhammad, L. Ag., of this college, has been appointed senior teacher of that class, *vice* Lala Lachhman Das, with effect from 21st March 1921.

B. Sc. (Agriculture) Examination.—Eleven students appeared in the examination for the B.Sc. (Agriculture): 6 were declared

successful, 4 have to appear again in one subject, and 1 has failed. Of the 6 successful candidates 2 passed in the second division and 4 in the 3rd division. This is the first Final examination for the Degree of B.Sc. (Agriculture) which has been held in the college.

F. Sc. (Agriculture) Examination.—Of 26 students who appeared in the F. Sc. Examination in Agriculture, 17 were declared successful and one came under the compartment rule. Sixteen of the successful candidates were placed in the second class and one in the third class.

Final Examination in Subsidiary Subjects for the B. Sc. (Agriculture).—Twenty-four students appeared in the final examination in the subsidiary subjects taken at the end of the third year of the course, and 22 were declared successful.

Examiners' Suggestions.—The examiners in the above subjects suggested some alterations for the improvement of the teaching of the courses, and these are being attended to.

Applications for entrance to the main courses given in the College, and students admitted.—There were 228 applications for admission to the main courses (Degree and Leaving Certificate) given in the College in May 1921. The standard of education of the applicants was quite as high as we have ever had. A very large proportion of the candidates had passed the entrance examination to the Punjab University in the first or second division, and a few had passed the F. Sc. in pure Science.

The applications and admissions to the main courses may be classified as follows: —

Source.	Applications.		Total.	Admissions.		Total.
	Agriculturists.	Non-agriculturists.		Agriculturists.	Non-agriculturists.	
Ambala ...	21	6	27	8	1	9
Jullundur ...	50	10	60	9	1	10
Lahore ...	26	14	40	8	2	10
Multan ...	23	12	35	9	1	10
Rawalpindi ...	18	17	35	5	2	7
Indian States ...	9	7	16	2	2	4
Other Provinces ...	4	11	15	4	...	4
Total ...	151	77	228	45	9	54

Rural Economy Class.—The Rural Economy Class, which lasts for one month and was held in March 1921, was attended by the following :—

Assistant Commissioners	...	3
Extra Assistant Commissioners	...	5
Zilladars	...	10
Co-operative Credit Society Inspectors	...	5
Total	...	23 students.

In this short course it is merely intended to show something of what is being done by the Agricultural Department, so that those who attend the class may be in a position, when they resume their ordinary duties, to advise farmers whom they meet as to how the Department can help them in their difficulties. We cannot make men agriculturists in this short course. Youngmen are most suitable for the class, both because they are likely to assimilate new ideas quicker than older men, and because they will serve the Province longer after going through the course. This class has been held now for the past 7 years, and my experience when coming in contact with those who have attended it is that they understand our work much more readily than people who have not gone through it. Also I think they help greatly in advertising the activities of the Department.

Vernacular Class.—There were 76 applicants for entrance to the Vernacular Class. It starts in October and is of six months' duration :—

26 students were admitted.

12 of these were employees of Co-operative Societies.

13 were sons of Punjab farmers.

1 was the son of a farmer in the United Provinces.

Scholarships.—The value of the scholarship for post-graduate study extending over two years has been increased from Rs. 60 per mensem to Rs. 75 per mensem, and the status of the research scholar has been raised from a third class to a second class officer for purposes of travelling allowance.

The following scholarships, awarded by District Boards, Indian States, other Provinces, etc., to their students are being availed of:—

District Board.	No. of scholarships.	Value of scholarships.
		Rs.
Dera Ghazi Khan ...	1	15 per mensem.
Jhang	3	12 „ each.
Hissar ...	1	6 „
	1	10 „
Shahpur ...	1	20 „
	1	25 „
Multan	1	15 „
Rohtak ...	2	15 „ each.
	1	7 „
Hoshiarpur	3	12 „ each.
Lyallpur ...	2	15 „ „
	1	10 „
Amritsar	2	10 „ each.
Gujrat ...	1	20 „
	3	15 „ each.
Gurdaspur	1	10 „
Jullundur	1	15 „
Karnal	1	7 „
Kashmir State	2	40 „ each.
Baluchistan	1	50 „
Patiala	1	40 „
Kapurthala	1	15 per mensem plus boarding house fee Rs. 32 per annum.
Faridkote	1	30 per mensem.
Sindh	6	30 „ each.
Delhi	2	15 „ „
Co-operative Societies ...	13	10 „ „

My hearty thanks are due to these District Boards and other donors for their generous help to the students of this College.

Teachers' Class.—Teachers from Vernacular middle schools get a course in Agriculture here, extending over one year to enable them to teach Agriculture when they return to the above-mentioned schools. There were 20 students admitted to the class in the past year, and 19 passed the examination at the end of the course, one student having left the class after Xmas owing to ill-health. This is the third batch of teachers that has passed out of the Agricultural College. These teachers are reported to be doing useful pioneer work of a distinctly practical character in the interests of rural education.

Attendance—In past years great difficulty has been experienced in getting students to join the College promptly at the beginning of terms, and to attend classes punctually. Strict measures have been adopted in order to promote punctuality. Slackness in these respects soon lowers the efficiency of the College greatly, and it is hoped that parents and guardians of students will do all in their power to help us in this matter.

As Mr. Roberts remarks in his report of the College in the preceding year, the efficiency of the College demands that the standard throughout should be jealously guarded, both in the interests of the future success of the institution and in justice to past students, especially those who passed out from 1912 to 1914 when the standard was very severe.

Health.—Fortunately the general health of the students, staff and employees, housed on the College estate, has been satisfactory, but with the increase in the numbers of these during past years, there has been increasing difficulty in providing medical attendance in cases of illness. We now urgently require a dispensary and a resident medical man. These have been asked for, and we hope to have them very soon.

Increase in staff required.—A lecturer to assist in the teaching of Agricultural Economics and English is now a vital necessity. The University Inspection Committee has drawn attention to this fact two years in succession, and I hope that this appointment may be made with all speed.

The same Committee has also drawn attention to the necessity for the appointment of an Associate Professor in each of the principal subjects in the degree course, *i.e.*, Agriculture, Botany and Chemistry. With the great increase in both our College and provincial work this is now a matter demanding very early attention.

Extensions to buildings, etc.—Extensions to laboratories and Hostel are urgently wanted. Material is being collected for extensions to the Chemical Section and it is hoped that the extensions to the Biological Sections will be pushed on very early. An additional hostel for students has been sanctioned and will be erected with all speed. We have practically no hostel room for vernacular class students this year.

Housing for staff on the College estate is very badly wanted in order to enable staff members to assist more in supervising students at their games, etc.

Sanction has been received for the erection of a swimming tank, and a square of land has been set apart for games.

It has now been decided that the Teachers' Class is to be taught permanently at the Agricultural College, instead of at the Teachers' Training College at Lyallpur. A separate Boarding House to hold 22 students and quarters for a Boarding House Superintendent are to be built for this class in our College grounds by the Educational Department.

As regards the prosperity of the College, the data given above speak for themselves.

D. MILNE,

Principal, Punjab Agricultural College, Lyallpur.

APPENDIX II.

Annual Report of the Economic Botanist to Government, Punjab, for the year ending 30th June 1921.

Part I.

Introductory.—I was on combined leave till 28th January 1921 and Lala Jai Chand, M. Sc., Assistant Professor of Botany, officiated while I was away (see also part II of this report.)

When on leave I visited places on the continent and in Britain, making enquiries on matters connected with our work here (see also part II.)

Wheats.—The season was the driest on record and exceptionally hot from 20th March to middle of April. The effects on the wheat crop were important and interesting (see part II).

We had under observation about 350 sowings of wheat including classified types, crosses, types found during District Surveys and foreign wheats. They occupied about 24 acres of land, 6 acres of which were non-experimental.

The types were grown as usual in long narrow strips, with a standard wheat at intervals to indicate variations in the quality of the soil. The largest plots were 1/8 acre each and were in square No. 31. On these, types 8-A, 8-B, 9-C, 16-A, 17-B, cross 2, cross 3 and Pusa 12 were tested against Punjab 11, each type in two sets of experiments. The net result is that cross 3 tops the list with 1 maund 25 seers more grain than Punjab 11. 8-A comes next with 1 maund 9½ seers in excess of Punjab 11, and Punjab 11 beats all others, *i. e.*, stands third on the list. Pusa 12 has given 4 maunds 12½ seers of grain per acre less than Punjab 11. A more full account of these and other wheat tests will be found in part II.

As it is important from the point of view of economy of land and staff to come to a decision as soon as possible regarding the relative merits of the types of wheat under extended trial by the Agricultural Department, we will review the trials on these very briefly. We are here looking for a wheat for general purposes, *i. e.*, one which in average conditions of soil and cultivation will give to farmers the best return over a number of years. 8-A and Punjab 11 are prominent competitors at present, although we have other types which have grains of better quality, and are heavier croppers in good conditions, etc. (see also part II.) Punjab 11 was one of the first wheats handed over by us to the farm for final tests. 8-A we had on our 1/32 acre plots, which give us useful information in 1913-14, and from that time its area has gradually increased. Up to date it has consistently yielded more grain and straw per acre than Punjab 11 in tests in the Botanical Farm. For the past five years we have tested it against Punjab 11.

on ¼ or 1/8 acre plots, and, comparing the grain yields from all the tests, the results are briefly as follows :—

In 4 years out of the 5, 8-A yields more than Punjab 11, and on the average of the 5 years 8-A yields 1 maund 29 seers more grain per acre than Punjab 11. Punjab 11 and Pusa 12 have been similarly tested against each other in the same square during the same period, and in this case the results are :—

Punjab 11 yields more than Pusa 12 in three out of the five years and on the average of the five years Punjab 11 yields 3½ seers per acre more than Pusa 12.

On the Agricultural Farm the Professor of Agriculture grew 8-A and Punjab 11 side by side for the four years 1916-17 to 1919-20 in square 26, the oldest square for wheat and cotton testing work on the Farm. In these tests 8-A yields more grain in 3 out of the 4 years and on the average of the 4 years 8-A yields more than Punjab 11 by 1½ seers per acre.

On square 43 he grew these wheats for the two years 1917-18 and 1918-19. The result is that 8-A yields more grain in the first year and Punjab 11 in the second, while on the average of the two years 8-A yields more than Punjab 11 by 1 maund 14 seers per acre.

On square 32 he grew them for the past two years and Punjab 11 yields more grain in the first year and 8-A in the second. On the average of the two years Punjab 11 yields more than 8-A by 2½ seers per acre.

Therefore simply taking the outturn figures given each year the trials made on lands under direct cultivation on the Agricultural Farm seem in favour of 8-A.

On the tenants' land on the Agricultural Farm the average of results of five years' trials calculated in the same way is that 8-A has given 2½ seers only more grain per acre than Punjab 11. For many reasons, however, the tests on the lands under direct cultivation should be more reliable than those on the tenants' lands. Pusa 12 was tested at the Lyallpur Farm and it was decided to be a worse cropper than Punjab 11.

At the Hansi Agricultural Station outturn figures of trials of 8-A *versus* Punjab 14 for four years show 8-A giving more than Punjab 14 in each year, and an average outturn of grain per acre of 3 maunds 7 seers in favour of 8-A for the 4 years.

Hansi trials of Punjab 11 *versus* Punjab 14 for 4 years show all 4 years in favour of Punjab 11 and on the average of the 4 years a balance of 2 maunds 1 seer per acre in its favour. Similar trials of Pusa 12 *versus* Punjab 14 show two years in favour of Punjab 14 and two in favour of Pusa 12, while on the average Punjab 14 yields 2 maunds 24 seers per acre more than Pusa 12.

For the Sargodha Seed Farm we have reports of 3 years' trials, and, calculated in the same way, the result is that 8-A yields more grain per acre than Punjab 11 in each year, and on the average of the three

years yields more than Punjab 11 by 2 maunds 19 seers per acre. Pusa 12 yields more than 8-A in two out of the three years, but on the average 8-A yields 1 maund 9 seers more grain per acre than Pusa 12, and, if two very abnormal plots were omitted, the wheats would stand in their usual order as regards cropping power, *viz.*, 8-A, Punjab 11 and Pusa 12.

At Gurdaspur on irrigated land 8-A, Punjab 11 and Pusa 12 have been grown for the past five years, but the Deputy Director's report for 1920-21 is not yet to hand.

In the 8-A *versus* Pusa 12 trials, 8-A gives more grain than Pusa 12 in three out of the four years and on the average it yields 2 maunds 27 seers per acre more than Pusa 12.

8-A *versus* Punjab 11 trials have been conducted for three years, but the 1920-21 report is not to hand. In these trials 8-A yields more grain than Punjab 11 in each of the two years reported on, and on the average yields more than Punjab 11 by 4 maunds 36 seers per acre.

On rainfall lands at Gurdaspur 8-A, Punjab 14 and Pusa 12 have been grown. In this case 8-A yields more grain than Punjab 14 in two out of the four years' trials reported on, and on the average of the four years 8-A yields 4 seers per acre more than Punjab 14. Punjab 14 yields more than Pusa 12 in three out of the four years and on the average of these years yields 27 seers per acre more than Pusa 12.

For a more full account of these trials see part II.

Ear-cockle in Wheat.—In the survey just made of the wheat crop in Karnal District it was estimated that the damage done by ear-cockle disease in the Panipat Tahsil alone that year was over one lakh of rupees. The people believe there is no cure for this disease, but our work on it for the past dozen years has shown that the cure is simple. It is hoped that measures will be taken to demonstrate this fact to farmers.

Cottons.—We had 18 acres under experimental cottons, and about 500 separate sowings. Some 400 were on small plots and 100 on larger ones. Half the latter were *Desis* and half Americans.

The cotton season was very hot and dry like 1919, and the effects on the crop were much the same (see part II).

In square 31 where the cottons got three to five waterings between the time they germinated and the end of October the average outturns from 4 acres of *Desi* Cotton—including many varieties—was 8 maunds 4 seers *kapas* per acre while from 4 acres of Americans—including many varieties—interstripped between them, the average outturn was 3 maunds 31 seers *kapas* per acre. The highest outturn of *desi* in that square was over 10 maunds *kapas* per acre from Roseum No. 132, and the highest outturn from the Americans was from 285-F., with over 5 maunds.

In square 28, where many Americans and *Desis* were also grown interstripped and the crop got 8 waterings between germination and the end of October, the outturns of *kapas* were about normal. On the

average of the plots where the soil was of fair quality and comparable, the Americans gave rather the better yields. The highest outturn was from American No. 72 which gave over 22 maunds per acre. Unfortunately part of the 285-F. plot was of bad land, but 285-F. did extremely well there, considering the soil on which it grew. The lints of the Americans on fair soil in this square were also good. This further supports our old conclusion that—

(*a*) We have now American types which can stand the severest heat and drought of the Punjab, and produce a good quality of lint,

(*b*) Will give a greater outturn of *kapas* than *desis* on fair quality of loam with suitable cultivation and irrigation,

(*c*) *Desis* varieties will pay best on lighter soils with poorer cultivation and irrigation.

I may also draw attention here to the fact that in rainy years on fair soil with fair cultivation Americans will pay better than *desis*, while on sandy soils with poor cultivation or in very dry years *desis* will pay better than Americans unless the Americans get more irrigation at critical times. In such seasons as 1919 or 1920 one or two waterings in August, two in September and two in October seem essential to ensure a good crop of American Cotton.

Regarding trials of 285-F. *versus* 4-F. Lieutenant Flowerdew, Military Farm, Okara, who has grown 285-F. against 4-F. for the past two years, reports that 285-F. beats 4-F. by about 1½ maunds *kapas* per acre and hopes to have 1,200 acres under 285-F. next year. The Extra Assistant Director, Montgomery, reports that 100 acres were under 285-F. in the past year; that it has done well everywhere and that as a result 1,600 acres have been sown this year.

The Professor of Agriculture has shown me 10 reports by farmers in this colony. Practically all of them prefer 285-F. to 4-F. We also hear that in Chak 232, Rakh Branch, where a farmer got seeds of 285-F. for one acre in 1918, most farmers are now growing only 285-F. The trials at the Agricultural Farm, Lyallpur, are believed to indicate that 285-F. does better than 4-F. on lighter soils with poor water-supply, and that the balance is in favour of 4-F. on heavy soils with a plentiful water-supply. The first point agrees with our own experience but not the second.

From our own trials, the trials on the Agricultural Farm and District Surveys we have also seen enough to convince us that our selected *desi* varieties are very much more profitable to farmers than unselected *desis*.

For further information regarding cotton work see part II.

Grams.—The season for grams was also bad. Types Nos. 7 and 17 seem promising. The experiments on gram wilt disease are becoming more interesting, and we hope will lead us to a better understanding of the disease in due course.

Potatoes.—The Scotch potatoes in Simla Hills did better than the local varieties as usual, and seed tubers are in great demand. New crosses are being reared (see part II).

Oats.—We have some improved oats for fodder purposes (see part II).

Sugarcane Disease.—Our experiments on Red Rot of Sugarcane are throwing more light on the methods that should be adopted in combating this disease (see part II).

Date Palms.—A gross income of Rs. 580 was got for 23 maunds 33 seers of cured fruits from 240 Arabian date trees at Muzaffargarh. At the urgent request of farmers we imported young date plants from Mesopotamia. We distributed 3,811 plants to applicants and kept 1,859 to ourselves. Owing to unrest in Mesopotamia the trees came late and many of them in bad condition (see part II).

Acknowledgments.—My warmest thanks are due to the staff, one and all, for their assistance in attempts to do something of practical value for the Province. This in many cases necessitates getting beyond the known point, a matter—as history everywhere bears out—only apparently easy after the discovery has been made, thoroughly understood, and demonstrated so that anyone may see it.

D. MILNE,

Economic Botanist to Government, Punjab.

APPENDIX III.

Annual Report of the Agricultural Chemist to Government, Punjab, Lyallpur, for the year ending 30th June 1921.

PART I.

1. *Staff.*—Mr. B. H. Wilsdon was in charge of the office of Agricultural Chemist till 23rd March 1921, from which date I have been working as Agricultural Chemist.

M. Barkat Ali, Bacteriological Assistant, returned to his duties on 24th November 1920 after one year's long leave.

Mr. D. K. Ambekar, M.A., who proceeded on sick leave for one year, breathed his last at his native place Birwadi on 25th September 1920. He was a very intelligent and reliable member of my staff, painstaking and accurate in his work, and the laboratory is all the poorer by his loss.

L. Parmanand, M.Sc., who was acting during Mr. Ambekar's absence, resigned his post and proceeded to England for further study. Bhai Kishen Singh, L.Ag., was appointed in his place on 9th August 1920.

Mr. S. M. Nasir and Pandit Lal Chand, L. Ag., were appointed assistants in the Bacteriolgical and Chemical Laboratories, respectively, from 1st April 1920 and 7th October 1920.

S. Gurdial Singh, Demonstrator in Chemistry, proceeded on long leave and B. Sher Singh, M.Sc, was appointed in his place on 18th October 1920. L. Lekh Raj, M.Sc., joined as Demonstrator in Physics on 5th October 1920.

2. *Provincial work.*—An abstract of the routine work undertaken is given below. Of these 171 samples were analysed for foreign departments and private individuals. Since Government has sanctioned my charging a fee for work done for private persons this kind of work has fallen off to a great extent, and thus I and my staff have been able to devote more attention towards research :—

Soils	93
Sugarcane	56
Manures	10
Food and feeding stuffs	7
Sugar beet	2
Miscellaneous	3
Total ...	171

In addition to these 803 individual samples were analysed in connection with the chemical investigations proceeding in the laboratory. In this connection I may oint out that quite a lot of work useful for the Agriculture of the province cannot be adequately attended to for want of sufficient staff. The nature of the problems which require an early solution, if agricultural conditions here are to be improved, is such as would demand the undivided attention of one or more wholetime assistants, and this under present conditions is not possible.

3. *Soil surveys.*—The detailed proposals for a properly organised staff for this were sent to Government last year, but they still await sanction. So no regular work could be started.

However a preliminary reconnaissance of the Sutlej Valley was undertaken and the different types of soil met with were analysed both chemically and mechanically.

The soil survey of the area covered by Jalalpur canal project asked for by the Government could not be undertaken for want of the abovementioned staff.

4. *Research reclamation of Barren Land* (*a*)—*Montgomery District.*—The details of the field operations which were carried on during the year are fully described in part II. It is satisfactory to note that the treatment of soil with gypsum and castor cake has yielded promising results as far as the yield of wheat is concerned. Another line of work followed has been the selection of a crop or crops best suited to the soil and climatic conditions prevailing on these lands. So far sugarcane seems to adapt itself better to these conditions.

In the laboratory some fresh experimental work to study the factors responsible for the barrenness of these soils has been started. It is a pity that owing to a limited staff at my disposal, this useful enquiry cannot be attended to so well as the importance of the subject demands.

(*b*) *Saline lands in the Upper Sohag Canal.*—A very interesting case of the formation of *kallar* has been observed at Pinjripur in Montgomery District. The work is yet in its infancy, but very useful data as to the causes which lead to the formation of Alkali will be available as the work progresses. It is hoped that the results will be of very great help in the solution of problems connected with the reclamation of saline lands in the Province.

5. *Soil moisture.*—(*a*) A memoir dealing with the theoretical portion and some preliminary investigations in the laboratory of the problems arising out of the movement of moisture in soil has been published under the name :—

"Studies in soil moisture," Part I.

(*b*) Further work in this connection specially with regard to the colloidal properties of the clay in soils by compressibility measurements and the effect of osmotic pressure of soil solutions on the moisture equilibrium was continued.

(*c*) *Field work.*—(1) Work in connection with the percolation of water from a watercourse reported last year is finished, and the results are ready for publication.

(2) A second observation well has been dug in the college lands to study the rate of the flow of irrigation water in the fields. So far only preliminary experiments could be tried. Actual test will begin as soon as the soil temperature thermometer is received back from England.

6. *Green manuring.*—Results obtained in past two years as to the value of the importance of green manuring for the conservation of moisture in light soils were confirmed this year both at Lyallpur and at Gurdaspur barani area.

A Bulletin comprising the data collected and the results indicated is ready for publication.

The work has however been extended both at Lyallpur and Gurdaspur and also in some of the barani tracts in the Doaba.

7. *Soil constants.*—For a proper study of the soil and its behaviour under different conditions it is very necessary to have a fair knowledge of certain soil constants such as moisture equivalent, hygroscopic coefficient, average diameter of a soil particle, etc. So far methods have been fixed for the determination of the moisture equivalent and the average diameter of a soil particle.

8. *Sullage disposal.*—Sugarcane is being grown on these plots. Engine and the water-lifting pump being out of order, sullage water could not be applied at the proper time, hence the crop is now being irrigated with canal water alone. Arrangements for the supply of even this are unsatisfactory and consequently the crop has suffered a considerable loss, amounting approximately to 40 per cent.

9. *Bacteriological investigations.*—(*a*) Study of nitrogen fixation in the Punjab soils in several districts was continued. Results are given in Part II of the report.

(*b*) Experiments with a view to bringing nitrogen fixation under control are in progress.

(*c*) Protozoa examination of Lyallpur soils has been taken in hand. Larger ciliates, small ciliates, amobæ and flagellates are all found to be present, It has been found out that the protozoa are present in Lyallpur soils even in the hottest and driest season of the year.

(*d*) Growth of Algæ in liquid medium is being studied: it was found that the growth begins to take place within four weeks in summer (April).

10. *Miscellaneous.*—*Sugarcane.*—Some analysis of the local and foreign varieties of sugarcane grown on the Gurdaspur Farm were performed.

A number of Coimbatore seedlings are grown there for the Sugarcane Expert to the Government of India, the object being to test whether the new varieties evolved at Coimbatore will succeed in replacing the existing local varieties. However as yet it is too early to advance any opinion on this point.

Standardisation of methods.—A good deal of work was done in connection with the standardisation of methods for the determination of nitrogen in manures and soils for discussion at the Conference of Agricultural Chemists held at Pusa on the 7th February 1921.

P. E. LANDER,

Agricultural Chemist to Government, Punjab.

APPENDIX IV.

Annual Report of the Entomologist to Government, Punjab, for 1920-1921.

PART I.

I.—General.

Teaching.—Physiology and Anatomy of the farm animals is receiving more attention in the teaching of Zoology. The time devoted to this science is, however, very little. To give adequate mental training to the students, and to supply them with sufficient facts to enable them to be competent agriculturists, it is essential that Zoology and Physiology should be taught during the first two years and Applied Zoology (including Entomology) restricted to the last two years of the College course. (At present the whole course of Zoology, Physiology and Entomology is finished in the first two years.) According to Professor Hickson, of the University of Manchester, 'no agricultural college can ever reach a second or even third rate rank without it' (*i.e.*, training in Applied Zoology).

Library.—Complete sets of some Entomological Journals have been added to the library, but it is far from being complete for purposes of higher research.

Laboratory—Is too small for teaching and inadequate for research. Extensions are very urgently needed.

Insectory.—So far we have been without an insectory, but no entomological work is possible without a proper breeding place for insects.

Research—Has improved in quality and quantity. We have during the last year contributed the following original papers :—

(1) Winter sprays against '*tela*' of mango gardens in the Punjab.

(2) Preliminary observations on the control of field rats.

(3) Preliminary observations on the Lethal temperatures for *Trogoderma khapra*—a pest of stored grain.

(4) Observations on the oviposition and life-history of *Microbracon*—a parasite of cotton bollworm.

(5) *Citrus Psylla* and its control.

The above were read before the Fourth Entomological Meeting held at Pusa. They will be published in the proceedings of the Entomological meeting, which I understand are in press.

(6) Problems of parasitism in Applied Entomology.

(7) Sprayings in the Punjab.

The above two papers were read before the Agricultural Section of the Indian Science Congress.

The following two papers were read before the Zoological Section of the Indian Science Congress :—

(1) Biology and Morphology of the Red Cotton Bug.

(2) Parthenogenesis in the Braconidæ.

Propaganda.—A travelling exhibition in Entomology and Sericulture was prepared. The exhibits include some 20 cases illustrating the life-histories of pests and useful insects. Full instructions on control of pests are added to the above show cases. Besides these, spraying machines, insecticides, traps, etc., etc., were also shown to the people. During the year under report five different places were visited. At Muktesar, where a counting machine was installed in front of the exhibition, more than 6,000 visitors to the entomological Camp were registered. It is essential to approach as many people as possible in order to let all know that a department exists that can render them effective help in fighting their insect foes. At present the ignorance of the masses concerning the activities of the Agricultural Department is appalling. We are far behind other countries in propaganda work, and it is time we organised this work on proper lines.

II.—Entomological.

Cotton.—The failure of the cotton crop in some localities was attributed to the bollworm, but on investigation the allegations could not be justified. The attack was in most cases below normal.

Special attention was devoted to the study of the parasites of the bollworms, and many new facts were brought to light.

Experiments to test the efficacy of the parasites in controlling bollworms were started, but the removal of muslin from our field cages put an end to our observations. The work will be restarted when we get an insectory.

Citrus Psylla.—Spraying against this pest is now practised on a large scale. It is, however, difficult to get suitable insecticides. It is hoped that spraying will become very popular among the citrus growers in the Punjab.

Mango.—The garden near Shalamar, Lahore, which was sprayed during 1920, was taken in hand. Last year it was during the flowering season that spraying was done. The hoppers breed at this time, and the young nymphs congregate round the floral buds and can easily be killed by spraying. This practice, however, is liable to damage the blossoms. It was, therefore, considered safe to try and kill the adult hoppers after the mango season. Spraying operations were started in summer, but it was found that hoppers were far too active to receive a thorough wash, and consequently escaped the effects of insecticides. A careful study of the habits of these insects revealed certain facts which were made use of for their destruction. It was noticed that the hoppers were very sluggish during the cold mornings of December. Low temperature has the effect of making insects inert and slow to move. The hoppers, which on a summer morning hop away when approached ever so gently, are so inactive on a winter morning as to allow one to catch

them with his fingers. It was thought advisable to try winter sprayings against this pest. Operations were started in January and spraying was done in the early hours of the mornings—5—9 A.M. The countings done after sprayings proved the efficacy of this method. It was estimated that from 50—70 per cent. of the hoppers were killed after a single spraying. The hand sprayers used for this work were not suitable for tall trees, and it was not without difficulty that we achieved success. The success of our operations is evident from the results given in Part II of this report.

I must mention that this work was done by my assistant, Lala Dina Nath, who had to conduct these experiments at considerable sacrifice of personal comfort. Starting work, day after day, long before sunrise, during December and January requires patience. Also great tact is needed to make the fieldmen leave their beds at that early hour.

Stored grain.—The researches were conducted along two different lines. Experiments were started to confirm Professor Dendy's results on 'hermetical sealing.' Professor Dendy maintains that grain kept in a vessel which is made airtight remains safe from weevil attacks. We did not obtain any definite results as the weevils in the experimental as well as the control flasks died. The experiments are being repeated on a larger scale.

The second line of investigation was to find out the effect of superheating on the insects of the grain and on the germinating capacity of the grain subjected to these processes. It was found that the larvæ of *Trogoderma Khapra* do not die if subjected to a temperature below 52°C. But if subjected to a higher temperature for a sufficiently long time (which varies with the temperature) they do not survive. The results of our researches were put to practice at the wheat godowns at Convillpur (Montgomery) and also at the elevator at Lyallpur. Superheating, if properly controlled, kills the insects without effecting the germination capacity of the grain. This method is more effective than fumigation and has the further advantage of being very much cheaper.

Elevator.—The grain elevator at Ly allpur was thoroughly cleaned. It has been found that weevilled wheat is brought in and stored without being subjected to a process by which the insects attacking it are destroyed. This is a dangerous practice and should be stopped as soon as possible. A superheating machine should be installed in connection with the elevator, and all grain received should be thoroughly cleaned of insects before storage. It is not only the loss of wheat as a result of insect attack within the elevator that we have to take into account, but we must also consider the future of this grain. The grain which is removed from the elevator may be stored elsewhere for a year or so, or it may be exported and remain in the hold of a ship for some weeks. If the grain is infested, however slightly, while in the elevator, the authorities in charge of the elevator are morally responsible for the loss that will occur sometime afterwards. Moreover, mixing attacked wheats with those unattacked is a practice harmful to the interests of those who send in clean grain. Of course it goes without saying that mechanical cleaning effected in the elevator only removes dust, dead insects and possibly adults, but most of the larvæ and eggs find access into the bins,

Rats.—This omnivorous pest has been conspicuous in its ravages during the year. In many places people had to resow their crops time after time. Gram has been its favourite food. Very successful operations were carried out in poisoning this animal. It must be said that isolated attempts are almost useless, and organised campaigns should be instituted against this—possibly the greatest—enemy of mankind.

III.—Sericulture.

We distributed 1,762 ounces of seed as against 600 ounces during 1920. The total amount of seed reared in the province was 2,162 ounces as against 1,000 ounces in 1920. Silkworm rearing was started in 8 new districts, 13 new tahsils, and 66 new villages; and 359 new rearers were trained.

Sericulture was practised in 46 schools of which 13 were new. Efforts are being made to make silkworm more popular in the schools. The Director of Public Instruction has promised to help us in this matter.

This season (1921) has been extremely unfavourable for silkworm rearing. Scarcity of rain had produced hard leaves and in smaller quantities. The abnormally high temperature (which was on certain days actually 13°F. above the normal) played havoc with the worms. In many cases the worms, which were so well looked after as to yield a very good crop, died off in a single day. Silkworms thrive best when the temperature is between 65°—75°F. (While the temperature during March went as high as 95°F) It was unfortunate that the season started too early and eggs were kept for incubation a little late. The hot spell during the first week of April did a great deal of harm. It came just when most of the worms were about to spin.

It might be mentioned that hatching was not at all satisfactory. The seed does not arrive here in time to undergo a full period of hibernation and is liable to give poor results. It is highly essential for the further development of this industry that grainage is started in this province. A trial grainage was started, but on account of excessive heat as explained above we could not get really first class cocoons for purposes of seed production.

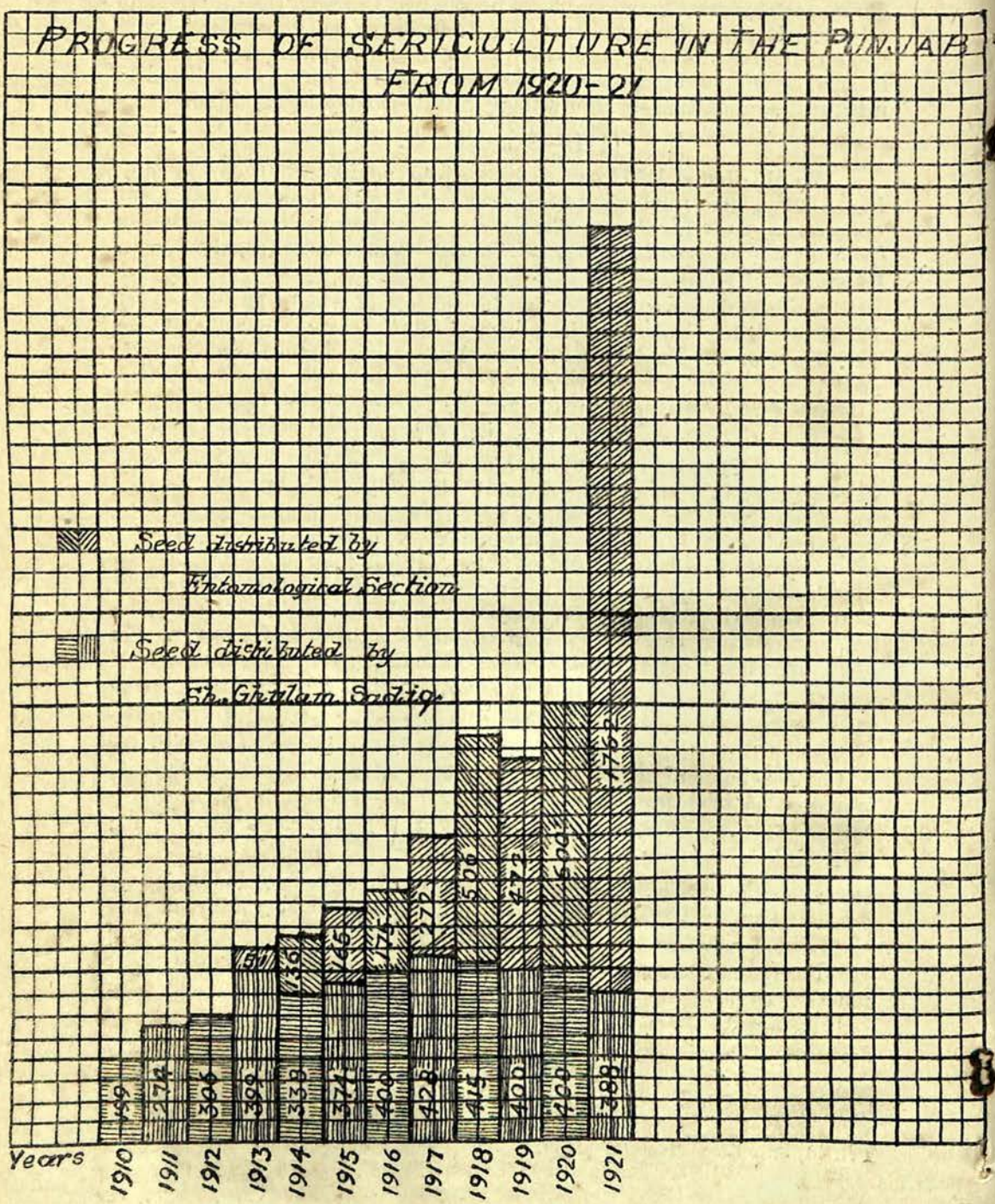
Poor hatching and high temperature were responsible for reducing the yield to 2 seers per ounce of seed. The highest yield this year was 12 seers per ounce as against 17 seers last year.

For the next season arrangements are being made to distribute 3,000 ounces of eggs.

As will appear from the above, the work, both Entomological and Sericultural, has increased considerably during the last year, while the section has remained understaffed. To cope with this increased work the whole staff has been put to considerable hardship. I have received very great help, both in teaching and research, from S. Hem Singh Pruthi, and Lala Harnam Dass.

M. AFZAL HUSSAIN,

Entomologist.



Figures indicate in ounces silkseed distributed.

APPENDIX V.

Annual Report of the Agricultural Engineer to Government, Punjab, Lyallpur, for the year ending 30th June 1921.

Introductory.—Mr. P. A. McCormack was in charge of the Section for the entire year under report, Mr. T. A Miller Brownlie, being on leave from 9th May 1920 until 26th July 1921.

Well-boring.—The object of this work is to increase the supply of water in ordinary wells, a staff of 20 well-borers and 20 mates being maintained for the purpose of operating 20 boring sets. During the year the number of bores sunk amounted to 392 as against 360 in the previous year when eighteen plants only were in operation. The number of bores from which an increased supply of water was successfully obtained is 326, representing a percentage of 83·16 as against 84·33 in the previous year. The number of borings in districts where strainers had to be used amounts to 176 as against 149 in the previous year, all of which were successful. Considerable difficulty was experienced in obtaining materials and great delay occurred in obtaining Railway conveyance for plant and material thus seriously hampering progress. Under these circumstances the outturn of work is satisfactory.

Tube wells.—The following tube wells were in progress during the year:—

1. *Jalalabad Tube Well in Mamdot Estate in Ferozepore District.*—In this tube well the original boring proved unsatisfactory and the well was rebored, this work being completed in March 1920 Owing to a fall in subsoil water level a different type of pump from that originally installed was required: this new pump has been received and its erection has been commenced.

2. *Lyallpur College Tube Well.*—The casing pipes required for this work arrived during the year and the boring has been completed. The pump is expected very shortly, but there is a probability of delay in completing the scheme as electric power is required to drive the pump, while the proposed electrification of Lyallpur Municipal area, which appeared to be on the point of realization some eighteen months ago, has meantime been postponed. It is hoped that the financial instincts of the business community of Lyallpur will soon awake to the advantages of the proposed undertaking and another revolution recorded on the wheel of progress.

3. *Muzaffargarh Tube Well for Date Palm Plantation of Economic Botanist to Government, Punjab.*—This small tube well was completed early in the year under report and is working satisfactorily.

4. *Veterinary College Tube Well at Lahore.*—The boring for this tube well was completed in May 1920 and completion of the work has been delayed on account of non-arrival of the

pumping plant and also owing to the fact that the Lahore Electric Company are not in a position to supply the necessary energy for driving purposes. It is probable, owing to the great delay between inserting and working the tube, that damage may have occurred to the tube which will have to be rectified before water can be obtained.

5. *Bahawalpur State Tube Well.*—The original estimate for this work provided for a boring not exceeding 200 feet in depth: a suitable subsoil however does not exist up to this depth, and during the year the boring has been continued to a depth of 423 feet without much improvement taking place in the prosity of the subsoil. Further boring cannot be continued with the present casing tube and therefore a strainer will be inserted and yield tested on the present boring.

6. *Dera Ismail Khan Tube Well.*—Boring work on this tube was only commenced in May, owing to difficulties in obtaining Railway transport for plant and materials.

7. *Gujrat Tube Well.*—The site for this proposed tube well has been selected by the local authorities, and after considerable delay in obtaining Railway transport for materials, etc., preliminary masonry work has been commenced.

8. *Makerwal Tube Well.*—Application has been received for a trial boring to ascertain if potable water is obtainable, and a sum of Rs 4,000 lodged towards the expenses of the work. It is probable that boulders will be met with in this boring and some heavy tools have been made to meet this contingency. Other tools may be necessary and these will be made as experience directs: meanwhile work will be commenced at an early date.

9. *Gurdaspur Farm Tube Well.*—This tube well was installed by outside agency before the Agricultural Department started this class of work. The supply of water appears to have diminished, and during the past year a new pump was recommended and installed by this Department. The affect of this alteration as reported by my Sub-Overseer is "The yield has improved to some extent."

Masonry Works.—Construction of the New Agricultural workshop at Lyallpur has been proceeded with during the year, the offices and stores being ready for occupation: final measurement and payment of the portions completed still remains. It has apparently been deemed necessary to carry out drastic additions to the original sanctioned plans for the most important item of the Workshop, namely, the Machine shop. Possibly advantages commensurate with the expense involved are believed to result from the alterations; these I have not yet understood, while the disadvantages are only too patent. Most of the machines required for the workshop arrived during the year under report and several of them have been mounted in positions where they can be worked for the time being. Unfortunately the question of the electrification of Lyallpur Municipal area is still unsettled and therefore arrangements have not yet been made for a power plant for the various machines. Construction of

the seed godown at Kala Afghanan for the Co-operative Credit Societies and of the small Ginning Factory at Hansi, mentioned in last year's report, were started during the year under report but work has since been suspended on account of funds not being forthcoming for completion of the work.

The proposals for roofing the Sugar Boiling plant at Gurdaspur mentioned in last year's report has been approved and work is in progress at the present time.

General.—The number of enquiries regarding lift irrigation plant does not show an increase over that for the previous year. High prices still prevailing for plant and material, etc., deter land-owners from embarking on projects, the cost of which will effect their returns for many years, while, by postponing improvements, they hope to obtain the advantages of a lower market.

The recent drought has resulted in a heavy demand for ordinary well water augmentation. An application was submitted in May for an increase of well-boring establishment to cope with requirements: a thirty per cent. increase would permit of work being undertaken in those districts where there are no borers at all and where borers are required and also in districts where the present staff is unable to keep up with boring requirements. Mr. McCormack has spent a considerable amount of time in experimental work on a cheap form of strainer made from bamboo splints. These strainers were wrapped round a length of perforated female bamboo and have been inserted in a few wells for trial purposes. Unfortunately Mr. McComack has left no record of the work he has done in this direction, nor of the results obtained, but I understand that the trials resulted in a satisfactory increase in water yield. The importance of a cheap form of strainer for this purpose has been under the consideration of a number of engineers for several years, and although bamboo has been used as a strainer for many hundred of years in China, we may yet see it in use in India under modern conditions.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government, Punjab, Lyallpur.

APPENDIX A.

WELL-BORING.

Serial No.	Name of District.	Wells.		Remarks.
		Number of Bores.	Successful.	
1	Multan	28	24	Ludhiana Circle: percentage of success 87·4: out of 151 there were 8 trial bores, all of which were successful.
2	Ferozepore	37	31	
3	Lahore	55	48	
4	Ludhiana	19	18	
5	Muzaffargarh ...	10	9	
6	Bahawalpur State ...	2	2	
	Total ...	151	132	
7	Jullundur	14	11	Jullundur Circle: percentage of success 78·6. The total number of bores includes 12 trial bores on proposed wells, all of which were successful.
8	Hoshiarpur	59	36	
9	Gurdaspur	12	11	
10	Gujranwala ...	16	15	
11	Shahpur	1	1	
12	Sialkot	25	19	
13	Amritsar	32	32	
	Total ...	159	125	
14	Gurgaon	18	18	Rewari Circle: percentage of success 81·1. Two were trial bores, one of which was successful.
15	Ambala	9	6	
16	Karnal	42	33	
17	Rohtak	12	11	
18	Delhi	1	1	
	Total ...	82	69	
	GRAND TOTAL ...	392	326	Percentage of success 83·16.

APPENDIX B.

DETAILS OF STRAINERS USED IN WELLS IN THE PUNJAB.

Circle.	District.	No. of strainers.	Average yield of well before strainer was used, gallons per hour.	Average yield after strainer inserted, gallons per hour.	Average cost per well.
					Rs. A. P.
Prior to July 1920.					
JULLUNDUR	Hoshiarpur	103	599	2,067	136 0 0
	Amritsar	79	765	3,373	184 0 0
	Gurdaspur	25	1,024	3,436	157 0 0
	Jullundur	1	930	3,000	180 0 0
	Gujranwala	28	566	2,470	137 0 0
	Sialkot	60	669	3,621	130 0 0
	Gujrat	1	545	1,925	137 0 0
LUDHIANA	Montgomery	16	630	2,600	150 0 0
	Lahore	123	584	2,066	149 0 0
	Multan	47	505	2,091	148 0 0
	Ferozepore	31	628	2,663	124 0 0
	Ludhiana	41	368	1,843	163 0 0
REWARI	Gurgaon	3	600	2,300	150 0 0
	Karnal	52	683	2,548	107 0 0
	Ambala	10	928	2,589	139 0 0
	Total	620	Average 668	Average 2,571	Average 146 0 0
From July 1920 to 30th June 1921.					
JULLUNDUR	Hoshiarpur	19	421	1,725	125 0 0
	Amritsar	34	665	4,000	200 0 0
	Gurdaspur	11	925	3,735	135 0 0
	Gujranwala	13	720	2,125	165 0 0
	Sialkot	14	312	2,575	145 0 0
	Shahpur	1	...	1,000	125 0 0
LUDHIANA	Lahore	22	825	3,087	211 0 0
	Multan	19	565	1,231	164 7 0
	Ferozepore	5	1,282	2,531	177 14 8
	Ludhiana	7	475	2,106	172 10 8
	Muzaffargarh	7	712	3,225	170 14 0
	Bahawalpur	4	593	9,537	349 0 0
REWARI	Karnal	18	453	2,610	89 0 0
	Ambala	2	658	9,476	253 0 0

APPENDIX VI.

Report of the Professor of Agriculture, Lyallpur, on District work for the year ending 30th June 1921.

THE area of the Lyallpur circle remains same as before, *i.e.*, the districts of Lyallpur, Sheikhupura, Jhang, Lower Bari Doab Colony, the rest of Montgomery District, parts of Lahore District, Multan, Muzaffargarh, and Dera Ghazi Khan. Active operations have been carried out in all except the three last mentioned, where very little work has been possible owing to paucity of staff. As the staff increases work will be taken up there also.

The season was very dry throughout and greatly hindered the work of getting good seed. The yield of cotton was poor throughout. The Lower Bari Doab Colony suffered even worse for canal water than the Lower Chenab Colony in the last rabi season, and the yield of wheat was very poor. At Lyallpur also the yield was below normal.

Farms.—On the Lyallpur farm numerous experiments with crops, implements, manures, irrigation, cultivation, etc., have been in progress. The results of these appear in the report of the Lyallpur Agricultural Station. Special mention may be made of wheats and cottons which are of immediate economic importance. In comparing the wheats Punjab 11 and Punjab 8-A there seems little to choose so far as the yield of grain is concerned. Of 87 tests made 44 were in favour of Punjab 11 and 43 in favour of Punjab 8-A. The average of all showed a balance of 13 seers 4 chataks in favour of Punjab 11. Here, as in the past year, Punjab 11 is slightly the better, but with this result it must be borne in mind that Punjab 8-A gives more bhusa than Punjab 11 and in addition is better liked by zamindars for their own food.

As in the previous year, 285-F American cotton was tested against 4-F. On the whole 285-F was the better, but on good land with plenty of water 4-F gave a slightly higher yield.

The Montgomery seed farm consist of 10 rectangles of which 2½ are under direct cultivation for experimental purposes and the remainder is cultivated by tenants. Owing to the bad season, great shortage of canal water and unevenness of the land, the results this year are very unreliable.

During the past year the Lahore District Board has started a demonstration farm at Raewind. Work has been begun and is in charge of an Agricultural Assistant under the Board.

A small Demonstration Farm has also been started by the Co-operative Society in Chak 89-6-R, and is already doing useful work. Four similar farms have been inaugurated in the Lower Bari Doab Colony in Chaks 141—10R, 42—12L, 78—4R, and 4-Kh. Minor. The Jail Farm, Montgomery, has also been working as usual. All these are under the direction of the Extra Assistant Director of Agriculture, Montgomery.

On the Narwala reh farm there has been an increase in the appearance of Kallar, the area affected amounting to 18 kanals as against 12 kanals last year. Extra water has been stopped. The yields of cotton and wheat were lower than last year. This farm is in reality not now under our control.

Cotton.—In the Montgomery District 10,525 maunds of 4-F American cotton were purchased for seed. Of this 8,785 maunds were actually sold for sowing purposes, the balance, not required for seed, being sold in the market. At Lyallpur the respective amounts were 9,060 maunds purchased and 5,140 maunds sold for sowing purposes.

100 acres of 285-F cotton were sown in the Montgomery District and 140 acres in Lyallpur

On the whole the impression created was very favourable, especially in the Lower Bari Doab Colony, where 1,604 acres have been sown this year. The area sown in the Lyallpur District is about 150 acres. The fact that its lint is finer and larger than 4-F and that the indications this year are that it will do better under adverse conditions than 4-F, will, if borne out during the next year or two, cause it to replace 4-F, our established American cotton.

The results of trials by zamindars are as follows :—

Statement showing results of 285-*F American cotton, given out to zamindars, as compared with* 4-*F American cotton in Kharif* 1920.

No. of plot.	Average yield per acre 285-F.	Average yield per acre 4-F.
	Mds. Srs.	Mds. Srs. Ch.
1	3 10	2 17 4
2	5 2¼	2 9 3
3	5 7¼	4 10 0
4	3 29¾	2 9 3
5	6 21¼	6 21 4
6	3 19¾	1 31 14
7	4 19¾	2 27 12

Cottons in lines.—The demonstration of sowing cotton in lines and interculturing was continued. The practice has now spread fairly widely and it is not now possible to give an estimate of the acreage so cultivated. Progress is very steady and on occasions our small staff were unable to give full assistance to zamindars, so many were the calls for help.

Desi Cottons.—Of the Desi cottons G. I. Mollisoni and G. N. Rosea have done equally well. The farm selected broad leaved G. Sanguineum did better than G. I. Mollisoni this year, contrary to last year's results.

Cotton, American.—Altogether 13 auctions were held, but four of these were in the Hansi Circle. In the nine auctions in this circle 27,289 maunds of Kapas were sold. As the market for American cotton has been fairly well established now the zamindars can get good prices in the ordinary market, and so are not bringing their cotton to the auctions in so great quantities as formerly. It is, however, still necessary to continue these markets in order that we may be assured of a supply of good seed and in some districts the zamindar makes a little more out of his crop.

Wheat.—The quantity of Punjab 11 bought by us for seed in the Montgomery District was 8,580 maunds, of which 6,546 maunds were sold for sowing purposes, the remainder being sold in the market after the sowing season. At Lyallpur 4,000 maunds were purchased and 2,841 maunds sold for seed.

Seed of Punjab 8-A was distributed for trial amongst a few selected zamindars in both the Lower Chenab and the Lower Bari Doab Colonies. The reports from them are very encouraging and most of them speak highly of this wheat, especially for cooking purposes.

The results are summarised as follows :—

Statement showing results of wheat Punjab type 8-A given out to zamindars for trial as compared with Punjab type 11.

No. of plot.	Average yield per acre type 8-A.	Average yield per acre type 11.
	Mds. Srs.	Mds. Srs.
1	17 39 3/16	18 17
2	5 37 1/2	... 6 10 13/16
3	12 6 1/2	15 10 1/2
4	14 37 1/4	... 13 30 1/4
5	19 6 1/2	21 22 1/2
6	15 11 1/4	13 19 1/4

Implements.—The work of making improved country implements continues at Lyallpur. The bar harrow still increases in popularity. The

number sold during the year was 438 against 341 last year. The other implements sold such as drills, hoes, markers, etc., are given below:—

Implements sold by the Agricultural Department (Lyallpur Circle) during the year ending 30th June 1921.

Implement.	No.	Price.
		Rs. A. P.
Bar harrows	438	12 0 0
Rabi seed drills	73	14 0 0
Kharif seed drills	43	14 0 0
Lyallpur hoes	39	11 0 0
Muna markers	32	1 9 0
Drag harrow	1	...
Spare parts, tools and accessories	548	...
Total ...	1,174	...

Many imported implements have been sold by firms during the year, but exact figures are not available. The popularity of Raja fodder cutters still continues. Even though the price has now advanced to Rs. 175 a total of 139 was sold in this circle during the year. Indeed so great is the demand that no sooner does a consignment reach the selling firm than they are at once sold out. Prices of all implements have been steadily increasing, and this reacts to a great extent on the sales. Demonstrations of imported machinery and implements have been given at a few places in this circle during the year.

In connection with the demonstration of implements, both country and imported, practical classes for farmers were held at Lyallpur twice during the year—July and February. These classes are for a period of fifteen days each, during which those who attend are taught the advantages of the use of all improved implements and are trained how to use them. The attendance at the classes has not been very good and steps are being taken to advertise them widely in the future. The class being held at present, though not in the year under report, is much more satisfactory numerically. It is encouraging to be able to say that those men who have attended the classes so far go back to their villages and make use of the knowledge they have gained.

Wheat Seed Farms.—So far, for the multiplication of good wheat we have to a great extent to depend on selected farmers who agree to give us the produce of pure seed which we supply them, and to carry on cultivation under our instructions. We experience however great

difficulty in getting the seed from these men just when we require it even though an extended period is fixed for delivery. This difficulty is more felt in the Lyallpur District where we have to deal with smaller land holders and hence with a greater number of them. To get over this difficulty it is hoped that we may be able shortly to acquire certain large estates in the vicinity of Lyallpur where we can produce the necessary seed ourselves.

Agricultural Associations.—Meetings were held half yearly by both the Lower Chenab Colony Agricutural Association and by the Lower Bari Doab Association. The attendance has been good. Keen interest is taken. The members of the Lower Bari Doab Agricultural Association were at their last meeting in favour of holding meetings quarterly, instead of half yearly. This was agreed upon, but practical effect has not yet been given to it. Useful work is being done through these associations. Very material assistance has been given to the Lower Bari Doab Agricultural Association this year by one of its members, J. L. Flowerdew, Esq., Manager, Military Oat Hay Farm, Okara, who, when the Association was in difficulties at their last meeting over the matter of 285-F Cotton seed for sowing purposes, generously gave for distribution amongst the members a large quantity of seed which he had intended sowing himself.

Acknowledgments.—Our thanks are tendered to F. H. Puckle, Esquire, I.C.S., Colonization Officer, Montgomery, for his unfailing assistance to us in all our schemes and at all times, also to B. H. Dobson, Esquire, O.B.E., I.C.S., Deputy Commissioner, Lyallpur, and to Khan Sahib Chaudari Sultan Ahmed, Deputy Commissioner, Montgomery.

Of our own staff excellent work throughout has been done by Chaudhri Muhammad Abdullah, and by Bhai Charan Singh, Extra Assistant Directors of Agriculture, at Lyallpur and Montgomery, respectively. Mention may also be made of Bhai Labh Singh, Bhai Kartar Singh, Chaudhri Anant Ram, Chaudhri Ata Muhammad and Bhai Jaimal Singh, all of whom have done very good work in their various capacities.

H. R. STEWART,

Professor of Agriculture, Punjab Agricultural College, Lyallpur.

APPENDIX VII.

Annual report of the Deputy Director of Agriculture, first circle, Gurdaspur, on District Work for the year ending 30th June 1921.

THIS is the first complete year that I have been in charge of this circle, which comprises about all the central and western Punjab districts as well as the Upper and Lower Jhelum canal colonies. Owing to insufficiency of trained staff work has been possible only in Hoshiarpur, Jullundur, Amritsar, Gurdaspur, Sialkot, Gujrat and the colonies, and though there are no Assistants to encourage direct propaganda work in Ludhiana and Gujranwala, they are by no means entirely neglected.

In addition to the three Government main experimental as well as seed and demonstration farms (*e.g.*, Gurdaspur, Sargodha and Chillianwala) there are four district board farms at :—

Jullundur,
Beas (Amritsar),
Sialkot, and
Gujrat,

and two more have been started for educational purposes in Khalsa College, Amritsar, and Borstal Jail Institution, Lahore. A private seed and demonstration farm has just been taken up in the backward tract controlled by the inundation Canals in Shahpur District, and some 10 rectangles for a Rice farm have been reserved at Kala Shah Kaku where the construction of the buildings, etc., before the actual experimental work is started is now being contemplated. This brings the total number of such institutions to 11 which have to be run along with ever-increasing and heavy demands for the district work ; hence the need of more staff is fully emphasized.

The lines of work adopted have been similar to those of the last year with some additions and are as follows :—

(1) Demonstration and seed farms.

(2) Demonstration and sale of improved agricultural implements.

(3) Sale of pure and improved seeds.

(4) Demonstration plots.

(5) Starting of co-operative seed and demonstration farms.

(6) Cotton auctions.

(7) Potato storage experiment at Sialkot.

(8) Agricultural Associations.

(9) Sale of lucerne and chari seeds as a special measure.

(10) General propaganda work, *e.g.*, sowing in lines Interculture, etc., and demonstrations at horse, cattle and other fairs.

1. Demonstrations and seed farms generally speaking, there is one such farm in each district situated at its headquarters. The object of such an institution is to form a nucleus of the propaganda work in that district and to maintain a continuous supply of pure seeds besides the demonstration and testing of various new crops for their acclimatization and adoption of local conditions. In addition to this it will in future keep a stock of various agricultural implements and their parts and when attracting the zamindars for their purchase will bring them in close touch with modern agriculture. They are of the following 3 types :—

(*a*) Government demonstration and seed farms.

(*b*) District Board demonstration and seed farms.

(*c*) Private demonstration and seed farms.

A.—Government Demonstration and Seed Farms.

Chillianwala.—Besides the two main farms at Gurdaspur and Sargodha, the Chillianwala seed farm (10 rectangles) is the only Government concern coming under this head. It is in the main sense of the word only a seed farm for the propagation and multiplication of the best wheat and cotton seeds. Hitherto it has not been able to fulfil its functions owing to provision of no funds, buildings or cattle, and has therefore been let out on lease. In the year under report it was taken over from the lessee and is now under our direct management. Half a square of land was under the direct cultivation by the department, on which new varieties of crop are grown before growing on the rest of the farm, and the remainder is given to tenants who have been recently brought from Sargodha. All the necessary implements for the farm and two pairs of Government bullocks have been supplied, and estimates for construction of permanent pucca buildings in place of the present kucha temporary ones have been submitted. Laying out and levelling of fields have been almost completed except a small portion of the low-lying land which represents the worst type of jungle. Cotton was the first kharif, giving 400 maunds of pure 4-F capable of growing 3,200 acres in the next year, and three types of wheats, Punjab-11, 8-A and Pusa 12 gave 780 maunds of wheat seed enough to sow 1,248 acres.

B.—District Board Farms.

Jullundur.—The farm consists of 56·67 acres, of which only 40 acres are cultuiable land, the rest being pure sand. It has only this year been brought under proper cultivation and the laying out in regular experimental plots has been completed. Owing to unfortunate state of the weather (4 inches rainfall) the reclamation work on the barani portion has been delayed and only the chahi area has so far been tackled. The rabi 1920-21 was the first crop under such conditions, but the following kharif is entirely according to the new cropping scheme drawn for the farm.

The Government allotted Rs. 30,958 for the acquisition of the land and a grant of Rs. 18,000 for construction of the farm buildings. They

have almost been completed and some of the staff and cattle have now been moved on to the premises. This will facilitate the hard work in front of us for reclamation of the lands and protection of the crops as well as to bring the farm under proper cultivation.

Beas.—The farm is under the control of the District Board, Amritsar, and has been in charge of one of its members. Owing to various reasons the arrangements have been defective, and it is now proposed to take over entirely from the Board. The present kacha buildings are not only too old and unfit for requirements, but are situated at a distance of half a mile from the farm. An Agricultural Assistant has now been put in charge and the work has begun afresh on the farm as well as in the district. The farm is now known in the surrounding country and has begun to play its part well.

Gujrat.—This is totally a District Board concern as the Government has made no payment for the land or buildings. It consists of about 55 acres of poor land, under-laid with a stratum of sand at variable distances of 1—4 feet from the surface. For the new scheme of the reclamation and redesigning of the work on the farm, relaying has been done. Farm buildings have been completed, but the manager's quarter is badly needed. The Government has now allotted Rs. 14,000 for the installation of a tube well to supply water to the farm; the surplus to be sold to the surrounding zamindars. Like the Beas farm this also suffers from the indifference of the Board and aggravated with continuously unfavourable weather its success has so far been limited. However, with the tube well and the return of better times the farm will soon improve.

Sialkot.—This tops the list of all other District Board farms. The regular work was undertaken only in early rabi of 1920-21 and the laying out of plots has been completed. The present satisfactory condition of the farm in such a short time since its inception is the result of the keen interest of the Board to which thanks are due.

The Government allotted Rs. 37,614 for the purchase of land and Rs 17,272 (subsequently raised to Rs. 26,000) for construction of farm buildings, which have now been completed and all the staff is residing at the farm. Sialkot has thus been treated more liberally by Government in this matter than other District Board farms and has very well responded to this liberality.

C. Private farms.—The Khalsa College farm at Amritsar, the Borstal Jail Institution farm at Lahore and the Sardarpur farm in Shahpur District are amongst the more important of such enterprises. Besides these, two leading zamindars in Jullundur and one in Ludhiana have opened large farms where trial of Motor Tractors and introduction of sheep farming is being done. This is a very healthy sign in the right direction; no doubt their commendable examples will soon be followed by other large land holders.

Khalsa College farm.—The laying out is being done, but owing to brick kilns and other deep and wide ditches it has not yet been completed. It is in charge of an Agricultural Assistant lent to the College

for the purpose and to take classes for Agriculture lectures. For the technical advice it is entrusted to the Department. A part of the area has been reserved as a " practising area " for the classes whose working hours have been arranged to give them sufficient time on the land.

Borstal Jail Institution farm.—Owing to extremely uneven land the laying out is in progress.

Sardarpore farm.—It is situated in a small village in the heart of the inundation canal tract of the Shahpur District, where big landlords are still ignorant of the agricultural improvements. A trained hand (" mukaddam ") and some necessary implements have for the present been lent to start off with and the farm is run entirely under the guidance of the Agricultural Department. It is making good progress and the rays of the new light are already enlightening the most backward zamindars in the surroundings, so much so that the whole village has adopted cotton sowing in lines with thorough interculture with bar harrows and Lyallpur hoes. The infection, I am glad to say, has spread to the surrounding villages, also where Raja ploughs and harrows are now in demand.

2.—Demonstration and sale of improved agricultural implements.

Despite the shipping difficulties and the climax to which the prices have reached the following implements were sold :—

Name of implements.	1918-19.	1919-20.	1920-21.
Raja ploughs	81	83	93
Meston ploughs	200	312	366
Cultivator	...	11	...
Spring-tined harrows	8	15	8
Raja reaper	1	3	2
Horse hoe	...	15	6
Raja fodder cutter	1	1	15
Lever harrows	...	1	...
Hand hoe	8	1	1
Meston shares	...	440	798
Winnower	...	1	1

In addition to this 70 bar harrows,
25 rabi and kharif drills,
4 chain harrows, and
7 Miscellaneous implements were sold.

Meston plough for its comparative low cost (Rs. 12 to Rs. 18) is by far the most popular, and the firm's inability to import sufficient numbers have prevented its wholesale spread in the province.

Arrangements have been made to open sub-machinery depôts at the various district farms with the head depôt at Gurdaspur, where efforts will be made to stock Meston shares and other cheap ploughs to facilitate and encourage their further sale amongst the zamindars. Construction work of bar harrows has been taken up on extensive scale at Gurdaspur, where good shisham wood can be had cheaply and therefore the cost of production will be kept low. A general keenness for the Raja reapers is manifest in the Lower Jhelum Colony, but owing to delay in the firms' arrangements in sending a stock of reapers to Sargodha and more especially to the plentiful supply of manual labour this year owing to small wheat harvest and the desire of the owners to cut their little crops themselves so as to prevent any loss or compensation to which may be added the excessive prices, the sale has been very limited.

The system of demonstration and that of itinerary beldars have been continued and proved very useful. A large number of implements was as in previous years lent to new zamindars in order to teach them their use.

3.—Sale of pure improved seeds.

The method adopted in disseminating pure seeds of the improved crops was described in the last report. The Government and various district farms ensure fresh supplies and seeds purchased from the selected zamindars' fields grown from seed issued by the Agricultural Department and reared under our direct supervision is gradually widening the sphere of such activities. Wheat, cotton and sugarcane are the most important crops of the circle, but Australian bajra, Japan sarson, lucerne, groundnuts, maize and gram also have some demand.

Wheat.—Punjab-11 in the canal colonies and Pusa-12 in the central districts are now very common, but 8-A, a selection of the Economic Botanist, Punjab, is proving a fatal rival to both. The experience on the farms is corroborated by the opinion of the zamindars that 8-A is in many respects a superior wheat to both Punjab-11 and Pusa-12, and the outturn per acre is generally greater, though from this year's experience it has not been confirmed. Pusa-12 being an early ripener escaped the dry scorching winds in March and April, and the adverse effects of early hot weather did not do much damage. But, on the other hand, 8-A being rather a late ripener succumbed to these misfortunes and was therefore reduced in yield. Punjab-11 and 8-A have fared equally well in the colonies, and this year about 4,000 maunds of 8-A and only 80 maunds of Punjab-11 (as the latter is already well spread) have been arranged for the next year's seed in the Lower Jhelum Colony. Besides this about 12,000 maunds of 8-A seed have been stored by the zamindars themeselves, and another 12,000 maunds were disposed of in the market at first class rates. As the work is fresh in the new Upper Jhelum Colony only 150 maunds of 8-A were sold last year, but 306 maunds, all that was available this year, have been stored for the next year's seed,

Amongst the central districts Gurdaspur and Jullundur are well advanced in seed propagation. Last year 1,378 maunds of Pusa-12 and 8-A were stored in Jullundur where 8-A is in greater demand (Pusa-12 already common) and besides meeting our own requirements about 500 maunds were exported to Sindh for seed purposes. For the next year's requirements, owing to failure of barani crop and only a small irrigated area, very little good seed could be purchased. At Gurdaspur in addition to 200 maunds of farm seed 890 maunds were last year stored and distributed.

The wheat crop on the whole was much below normal, owing to adverse weather conditions and insufficient canal supplies, and though the demand for seed will no doubt exceed our supply, we were unable to collect any more, as the zamindars hoping a further rise in the prices were unwilling to part with their stocks at this juncture. Barani crop was a complete failure.

Wheat surveys.—In order to find out exactly the acreage covered by the various departmental wheats it was intended to carry out a survey of 8-A, Punjab-11 and Pusa 12. This would not only give a correct acreage of each variety grown, but, if carried out every year, will show the progress with each and will demonstrate graphically the annual increase or decrease as the case may be. But unfortunately owing to being understaffed this work could not be satisfactorily done except in Shahpur (Canal colony), Gurdaspur and Jullundur districts. Figures though somewhat incomplete, are :—

		Acres.
Shahpur (L. J. C.)	Punjab-11 ...	70,000
	8-A ...	3,375
	Pusa-12 ...	120
Gurdaspur ...	Pusa-12 ...	15,000
	8-A ...	900
	Punjab-11 ...	800
	Pusa-4 ...	430
Jullundur	Pusa-12 ...	1,240
	8-A ...	300

8-A has only recently been introduced, but is quickly ousting all others out and will very soon reach the top.

Cotton.—Lower and Upper Jhelum Colonies are by far the greatest cotton-growing tracts in this circle, but only desi cotton, for purposes of home consumption, is grown on very small scale in the rest of the districts. Like the last year this was also an unfavourable season for the cotton. For full details of the causes of the failure of the last year's crop my last report may be consulted. Absence of rains and want of canal irrigation at the critical time of August, September and October again reduced the yields this year, but the desi cotton, which

comprises 18 per cent. to 20 per cent. of the total area under cotton in the Lower Jhelum Canal Colony however fared better, as its water requirements are somewhat less and independent of definite times unlike the Americans. With the successive failures of the American cottons in the last three kharifs and the fall in prices the area has this year been very much reduced and times of the desi have again returned. In spite of the difficulty felt in securing good seed for the next year's crop 6,600 maunds of pure 4 F. cotton were arranged for and stored in the Departmental seed depôts in the Lower and Upper Jhelum Colonies. Three thousand eight hundred and three maunds in the Lower Jhelum and 1,362 maunds in the Upper Jhelum Colony (sufficient to grow 41,320 acres) were actually disposed of for seed; the remainder being sold in the market.

Sowing in lines has been done on a very large scale and over 12,000 acres of good crops in lines are standing in the Lower Jhelum Colony alone. In the Upper Jhelum Colony the work was started only recently and 500 acres of cotton are in lines. Sowing in lines and interculture of other crops like maize, groundnuts, &c., is being taken up.

Sugarcane.—The crop on the whole was much below the normal. Barani crop failed altogether except where grown on low-lying and bet lands. The following are our farm selected varieties with the zamindars :—

Varieties.	*Area in acres.*
Behar and Yuba ...	250 in Gurdaspur District.
J-105 ...	15 „ „ „
Dhaura ...	12 „ „ „
Burli ...	11 „ „ „

Co. 205 and Co. 202 are imported canes from Madras and are the progeny of a thick cane crossed with Sacchrum Spontanium (ordinary sarkanda). They are thin leaved intermediate varieties and possess a very deep rooted system. Co. 205 is very promising both in chahi as well as barani (yield at Gurdaspur Agricultural Station Chahi 55 maunds and barani 27 maunds of gur per acre) and has this year been given to a zamindar also for trial. Although the demand for its seed was extremely high yet as it has not been fully tested it was not widely distributed.

Owing to the approach of early and suddenly very high temperature in March the sets buried under ground were over heated, with the consequent shortage of sugarcane seed. This, together with unfavourable weather, has for the next crop decreased the area considerably.

1.—Demonstration plots.

This is an extremely successful line of work and is being extended as far as the limited staff can efficiently control. The exact procedure was explained in last report. Gurdaspur has by far the greatest number of such plots which rose to 30 as against 17 of the last year. Similar plots are now being started in Hoshiarpur, Jullundur, Sialkot and Gujrat districts.

The results are summarized below :—

Wheat—Cultural-tests—Gurdaspur District.

Kind of cultivation.	No. of village.	No. of plots.	Operation.	Outturn per acre. M.	S.	C.
Barani ...	29	29=Wheat ...	Farm method ...	4	17	9
		29= Do. ..	Country method ...	3	4	12
Irrigated ...	1	1= Do. ...	Farm do ...	9	37	15
		1= Do. ...	Country do. ...	8	11	9

Wheat—Varietal-tests—Jullundur and Hoshiarpur Districts.

Kind of cultivation.	No. of villages.	No. of plots.	Outturn per acre. M.	S.	C.
Chahi	3	2=Pusa-12	16	39	0
		2=8-A	15	38	0
		1=8-A	18	27	0
		1=Local 13 ...	22	20	0
Barani	3	1=Local 13	5	30	6
		1=8-A	5	4	12
		1=Local 13	3	10	0
		2=8-A	3	15	0
		1=Pusa-12	2	18	8

NOTE.—8-A grains became shrivelled. Wheat crops failed in barani plots in Jullundur District.

Wheat—Cultural-tests—Jullundur District.

Kind of cultivation.	No. of village.	No. of plots.	Operation.	Outturn per acre. M.	S.	C.
Chahi ...	6	4=8-A ...	Raja plough ...	9	22	10
		4=8-A ...	Country plough ...	8	39	12
		2=Local 13 ...	Raja plough ...	12	0	0
		2=Local 13 ...	Country plough ...	11	17	2
Barani ...	2	2=8-A ...	Raja plough	1	17	0
		2=8-A ...	Country plough ...	3	7	8*

* Represents average of one plot only—the other plot failed totally owing to drought.

Wheat—Cultural-tests—Hoshiarpur District.

Kind of cultivation.	No. of villages.	No. of plots.	Operation.	Outturn per acre. M. S. C.
Chahi ...	1	1=Local wheat ...	Raja plough ...	14 39 11
		1= Ditto ...	Desi do. ...	14 39 11
Barani ...	2	2= Ditto ...	Raja do. ...	6 29 4
		2= Ditto ...	Desi do. ...	5 31 4

5.—Starting of Co-operative seed and Demonstration farms.

This is a new line of work introduced this year. In view of the growing demand for demonstration plots and the difficulty to cope with it with the very small staff propaganda work in the form of co-operative seed and demonstration farms has been designed The idea underlying this scheme is to bring as many zamindars in contact with such centres as possible and though with a demonstration plot only one individual or one village at the most is concerned, a good number of villages will be involved in the new scheme. Its rules and regulations have been drawn out in consultation with the co-operative Department and arrangements are made to set it on foot.

6.—Cotton Auctions.

As usual several cotton auction sales were held in the Lower and Upper Jhelum colonies at the main trade centres with the addition of Malakwal to the list. Last year, as a beginning, only one sale was held at Bahauddin in the Upper Jhelum Colony, but as at Sargodha two were held this year, total number being 8. Such sales are very useful in new places where factory owners cannot so easily secure large quantities of good stuff, but where cottons are grown extensively some difficulty in disposing it in the auctions is always felt. However; but over a thousand tons of good American cotton were sold this year at auctions in this circle.

7.—Potato storage experiment at Sialkot.

The need of such an experiment was explained in the last report It was repeated on similar lines, and the results like those of the last year are quite successful. There seem to be three main enemies of the stored potatoes, *i. e.*, the moth borer, the fungus pests, and a high temperature. A note explaining the detail of the work done and the conclusion so far arrived at was published. In storing potatoes the following should be borne in mind :—

(*i*) Different varieties should be grown, harvested and stored separately.

(*ii*) Seed used should be free from fungus infection.

(*iii*) Rotten and decayed potatoes should be burnt and not merely thrown away in fields.

(*iv*) Stores should be well ventilated and with pucca floors as far as possible: otherwise they should be matted, and should be properly wire-gauzed. Ventilators should be kept open during storage period.

(*v*) Stores should be fumigated with sulphur before use.

(*vi*) They should be situated in some cool place. Shade of trees is useful. Underground cells keep low temperature and are more suitable.

(*vii*) Potatoes to be stored should be fumigated with petrol vapours and treated with corrosive sublimate as far as possible.

(*viii*) Storage under sand is also useful.

8.—Agricultural Association.

A new association was formed in Gujrat District where two successful meetings were held. All others met as usual twice in the year and discussed some of the most interesting and important topics of the day. The members selected represent real zamindars and the discussions in the meetings are keen and useful.

9.—Sale of Lucerne and Chari seeds as a special measure.

(*a*) The Lower Jhelum is a very great horse-breeding colony and therefore large areas are annually put under fodders. Moreover the zamindars are still fond of cattle and maintain large herds of milch animals. Lucerne is grown everywhere, but owing to a great scarcity of its seed 4,114½ lbs. of good seed from Australia were imported in September and distributed in the colony.

(*b*) With failure of last year's monsoon, and consequent shortage of fodder, the little chari crop that had been sown was all consumed and no seed was kept, except in the colonies, for the the next year. This was realized early and steps were taken to import some from wherever we could. Thus 3,000 maunds of good seed were imported and distributed in Hoshiarpur, Jullundur, Amritsar, Gurdaspur, Sialkot and Gujrat Districts besides supplying indents from Montgomery, Lyallpur as well as the Army Remount Depôts. The demand and appreciation were so keen that the small supply was finished in no time and further arrangements for import are in hand. This is a very charitable step gratefully appreciated by the zamindars

Staff.—There has been no change. M. Fateh-ud-din, Extra Assistant Director of Agriculture, was of great value and relieved me of a great deal of heavy office routine as well as general agricultural work in the circle. M. Mukhtar Nabi and Qazi Sami Ullah held the charge of Gordaspur and Sargodha farms respectively and

their work has been very satisfactory. Bhai Nand Singh also deserves mention. Like the trained agricultural posts the need of strengthening the clerical staff is badly felt, and though the return of the second clerk from Hansi has helped, more staff is still needed. M. Barkat Ali and Lala Manohar Lall deserve mention. The former as Head Clerk is well qualified for the work and is very reliable.

M. SULTAN ALI,

Deputy Director of Agriculture, Punjab.

APPENDIX VIII.

Annual Report by Sardar Darshan Singh of Vahali, I. A. S., Deputy Director of Agriculture, Punjab, Hansi, on District Work, for the year ending 30th June 1921.

General.—The year under report has been very dry. There was very little rain in the whole of the circle except in July and August 1920. The barani kharif suffered badly on account of drought and practically no barani rabi could be sown at all except in some parts on light sandy lands only. This also subsequently failed on account of the absence of winter-rains and of the high western winds in February and March.

The water supply in the canals was also very precarious and the irrigated crops also suffered much for want of water. The outturn was greatly reduced. Most of the irrigated wheat in the Hissar District was sown very late in the latter part of November and in December. The area has also been reduced. The inundation canals in Ferozepore District practically altogether failed.

The main branches of district and demonstration work may be summarized under the following heads, namely :—

1. Distribution of improved seeds to cultivators.

2. Arrangements for the disposal of the produce of improved seeds by auctions, collective sales, or private arrangements.

3. Efforts to multiply the pure and best varieties of seeds, and their proper storage.

4. Demonstration of improved methods of cultivation and the raising of crops.

5. Demonstration of the improved implements recommended by the Department, and instruction of the cultivator in using them.

6. Agricultural Associations.

7. Demonstration farms, demonstration plots and seed farms.

8. Supplying general information to the cultivators of the Circle.

Cottons.

A. American.—The district of Ferozepore is really the only district in my circle which presents a hopeful field for the cultivation of American cotton. In Hissar water is not available early enough and cotton is chiefly sown in the stubble of wheat and quite frequently after the burst, and with the help, of monsoon rains. There is again generally a deficiency of water in the months of September and October. In Karnal cotton is considered a secondary crop, and sugarcane is given preference. Sugarcane sowings are continued till about the middle of May, after which it gets late for American

cotton. The area under American cotton (4-F) in Kharif 1920 was as follows :—

Ferozepore District—

	Acres.
Ferozepore Division	22,131
Jagraon „	1,264
Bhatinda „	3,721
Rohtak District	1,500
Hissar „	750
Karnal „	350
Gurgaon „	60
Total ...	29,776

But American cotton in Ferozepore District had very severe set back this year from the following reasons :—

(*a*) The season was unfavourable owing to drought.

(*b*) The price of cotton was low owing to dull market.

(*c*) There being no local ginning factory in Ferozepore District the buyers had to rail away the kapas (seed cotton) and there were special loading difficulties this season.

(*d*) Owing to fodder famine zamindars who grew fodder made more money.

Auctions.—Auctions were organised at Abohar, Moga and Kotkapura. At the first auction at Abohar, about fifty thousand maunds of kapas were brought in, but there being no buyers the auction had unfortunately to be postponed. At the subsequent auctions at Abohar, Moga and Kotkapura 11,206, 1,100 and 20,180 maunds of kapas were received and auctioned respectively. The prices ranged between Rs. 11-2-0 for the special, to Rs. 7-13-0 for the D class.

Great efforts had been made to keep the crop pure and weeding out of cotton plants of other varieties had been attended to, with great zeal by the cultivators, who received good prices last year; but they were disappointed with the low prices obtained this year.

The quantities in other districts were not sufficient to enable us to hold auctions and arrangements were made with local factories to give a premium for American cotton; while in Karnal District, where such arrangements were not possible, the cotton was collected from different villages and railed to Lyallpur, where it was sold. The premium distributed to the zamindars, after deducting freight and other charges, was over Rs. 2 per maund.

B. Desi cotton.—The selected Neglectum white flowered Bhatla has gained much popularity and is in great demand among zamindars. Most of the seed of this variety during the last crop was distributed in villages within a radius of 5 miles from the Farm to ensure thorough supervision. The produce (about 1,600 maunds of kapas) was purchased, and as ginning plant has not yet been put up at the farm it was ginned in one of the factories at Hansi, and about one thousand maunds of seed was available for distribution this year, though the demand for it was very much more, as it is very popular with the cultivators of my circle. The lint percentage, even, on a quantity of 1,600 maunds ginned at the factory, was 37·35 per cent. as compared to 33 or 34 per cent. of the ordinary Desi kapas. Owing to the reasons mentioned already, Desi cotton is much more suited than American to this part of the Province. The yield of white flowered Bhatla on zamindari lands has in some cases been reported up to 18 maunds per acre.

DEMONSTRATION OF SOWING COTTON IN LINES.

I give below a list of various demonstrations held to teach cultivators methods of sowing cotton in lines. I am glad to say that most of the area under our cottons has been sown in lines.

Villages in which demonstration of sowing cotton in lines was given :—

Rohtak District.	*Hissar District.*
Balandpur.	Bhatla.
Rohtak.	Shekhpura.
Bohtar.	Hansi.
Kalanaur.	Majra.
Chiri.	Narnaund.
Bhainswal Kalan.	Ahli Sadar.
Rithal.	Ralli.
Ahluana.	Bahauddin.
Lahli.	Khanda Kheri.

Wheat.—8-A was given an extensive trial in all the districts of my circle, where work is in hand, and about 4,000 acres were grown under this type.

It is reported to have given very good yield from all quarters and the grain is amber-coloured, large and hard and is liked by the growers. The yield in some cases has been reported up to 40 maunds per acre with the cultivators. This wheat has gained popularity and is in great demand ; for the present year's sowing about 5,000 maunds of this seed has been stored with the Department and the zamindars for the distribution in the coming season.

The area under other wheat types during the last season was about 5,000 acres, besides large area under Pusa-12 in the Panipat Tahsil. Pusa-12 is also popular on the well irrigated lands of Ferozepore District, where its area was about 3,000 acres.

Sugarcane is a very important crop in the district of Karnal. Local varieties grown there are Suretha and Lalri. Last year Bihar and Yuba were tried at 2 different places in Karnal District, but no reliable results could be obtained owing to the unfavourable seasonal conditions.

In the district of Ferozepore where thick cane is chiefly grown striped Mauritious cane was grown and it did fairly well. Its trial is being continued this year at Jallalabad, Ferozepore and Sanday.

Another variety of thick cane obtained from Saharanpur is under trial at Jallalabad.

The experiment to check Red Rot in canes is being continued.

Rice.—The Basmati of Jubbalpur and Basmati of Sialkot were sown at the Jallalabad Farm, but owing to the failure of inundation canals no results are available.

Barley.—The trial of barley varieties was continued in Gurgaon District. Type No. 4 like last year has done best and is an early ripening variety. Its yield has been up to 30 maunds per acre.

Miscellaneous crops.—Lucerne, Japan rape, and oats were successfully grown at various places. Groundnut and castor plants are also being given a trial in Ferozepore and Hissar Districts.

Green Manuring.—Eight acres of san hemp were ploughed in at Poohla in Ferozepore District as preparation for wheat crop. The outturn per acre of the subsequent wheat crop was 20 maunds as compared with 13 maunds of an unmanured adjacent field.

Zamindars who had grown gowara for green manuring purposes fed it to cattle owing to the scarcity of fodder. Green manuring with san was also tried for reclaiming saline soil.

Demonstration of improved Agricultural implements.—Demonstrations of improved agricultural implements were given at different places in the circle. The number of villages in each district in which demonstrations were held during the year is given below:

Hissar	... 16	Ferozepore	... 12
Gurgaon	... 4	Karnal	... 4
		Rohtak	... 16

Special mention may however be made of the demonstration of agricultural implements and agricultural exhibition held at Muktsar during the Maghi Horse fair. The District authorities took keen interest and an exhibition of the local produce was organised. Exhibits from Botanical and Entomological sections were also invited and were visited by thousands of cultivators collected there. A ploughing match was also held and prizes given.

The Rohtak District Board held a similar exhibition of the local produce and ploughing matches at the Jahaz Garh cattle fair, and the Hissar Board at the Autumn cattle fair at Hansi and awarded prizes.

The Ambala District Board also held an exhibition of agricultural produce and awarded prizes.

I am much obliged to the District Boards of my circle who are all waking to the call of Agriculture and taking keen interest in all Agricultural improvement and are ready to assist in every way.

Introduction of improved implements.—The following implements have been sold during the year :—

Raja ploughs	...	28
Meston ploughs	...	73
Sabul plough	...	1
Little Marvel plough	...	2
Spring Toothed harrows	...	2
Bar harrows	...	5
Fodder Cutters	...	6
Hand hoe	...	1
Miscellaneous (such as country ploughs, carts, (etc., etc.)	...	42
Total	...	160

Agricultural Associations.—Four of the districts of my circle have Agricultural Associations which do propaganda work, *i.e.*, Ferozepore, Hissar, Karnal and Rohtak. These associations are doing very useful work. Two meetings of each of the agricultural associations were held during the year under report, except Ferozepore, which held only one.

Demonstration Farms.—The total rainfall at Rohtak was 7·69 inches. Both the Rabi and Kharif crops suffered from drought and the winds in September as well as February and March did damage to cottons and wheats respectively. There were practically no Barani crops, while the shortness of canal water did not give our irrigated crops a fair chance either. Out of 7 acres of cotton only 3 were sown with the help of canal water, while subsequently only two acres could receive one watering each after sowing.

Rohtak Demonstration Farm.

Six acres were under wheats. Out of these some received only one watering, while others received only two after sowing. The average yield in the first case has been 9 maunds 10 seers per acre, while in the latter 12 maunds 25 seers per acre. The highest outturn is 14 maunds 20 seers per acre. Under the famine conditions of the present year it could hardly be expected that the farm would pay, specially as our irrigation "*haq*" is only 12 acres (6 Kharif and 6 Rabi). In fact with such a small irrigated area it will be difficult to make the farm pay unless it is extended. The total expenditure of the farm was Rs. 1,658-10-9, out of which Rs. 731-8-0 are the wages of beldars and labourers. The income of the farm is Rs. 650-1-9.

Jallalabad Demonstration Farm.

The area of Jallalabad farm is now 100 acres : out of this about 65 were put under rice, but owing to the failure of inundation canals these were fed to cattle. Wheat 8-A did well at the farm and gave an average outturn of 20 maunds per acre. French oats were grown for fodder. These became very tall and were liked by the cultivators. Japan Rape gave green fodder at the rate of 350 maunds per acre. The total income of the farm was Rs. 6,866-7-0 against an expenditure of Rs. 5,024 giving a net income of Rs. 1,842-7-0 .

Guru Harsahai Farm.

The tube well failed, and the crops suffered for want of irrigation. There were of course no Barani crops owing to the failure of rains, and consequently the farm was in loss. This of course would not be the case under normal conditions.

Demonstration plots.—The Bahauddin demonstration plot is growing American cotton and 8-A wheat under our directions, and at the Bhatla demonstration plot we have 50 acres of selected desi cotton and had 20 acres of wheat. The zamindars were pleased with the outturn received. In the demonstration plot of Chaudhri Ali Muhammad of Narnaund all cotton was sown in lines. At the Palwal demonstration plot 5 acres of wheat 8-A yielded on an average 20 maunds per acre, and the owner, Chaudhri Chandan Singh, Zaildar, is also trying our cottons. Six demonstration plots in Rohtak, 4 more in Hissar and 4 in Karnal have been selected and work is being started on them.

But the lack of staff is a very great hindrance. As mentioned in my last year's report, I approached Director of Agriculture to get sanction for 4 more Mukaddams, but two only have been sanctioned. With the increasing agricultural activities in the circle it is necessary to provide adequate field staff to cope with the work.

Training of Inspectors and Sub-Inspectors of Co-operative Societies and demonstration to zamindars at the Farm.

All the Inspectors and Sub-Inspectors of Co-operative Credit Societies working in the districts of my Circle with their Assistant Registrar were received at the Hansi farm and given a short course of lectures and practical training. Parties of Revenue Officers and cultivators of the districts of this Circle were received and shown the various experiments that are being conducted at the Hansi Agricultural Station, as well as the improved implements at work.

DARSHAN SINGH,

Deputy Director of Agriculture, Punjab, Hansi.

PRINTED BY
THE SUPERINTENDENT GOVERNMENT PRINTING, PUNJAB
62 DA—500—1-11-21—SGPP Lahore.

REPORT ON THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, PUNJAB, FOR 1921-22.

Revised List of Agents for the sale of Punjab Government Publications.

In the United Kingdom.

Constable & Co., 10, Orange Street, Leicester Square, London, W. C.

Kegan Paul, Trench, Trübner & Co., Limited, 68-74, Carter Lane, E. C., and 39, New Oxford Street, London, W. C.

Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.

T. Fisher Unwin, Limited, No. 1, Adelphi Terrace, London, W. C.

P. S. King & Son, 2 & 4, Great Smith Street, Westminster, London, S. W.

H. S. King & Co., 65, Cornhill, and 9, Pall Mall, London.

Grindlay & Co., 54, Parliament Street, London, S. W.

W. Thacker & Co., 2, Creed Lane, London, E. C.

Luzac & Co., 46, Great Russell Street, London, W. C.

B. H. Blackwell, 50 and 51, Broad Street, Oxford.

Deighton Bell & Co., Limited, Cambridge.

Oliver & Boyd, Tweeddale Court, Edinburgh.

E. Ponsonby, Limited, 116, Grafton Street, Dublin.

Messrs. Wheldon & Wesley, Limited, 28, Essex Street, Strand, London.

On the Continent.

Ernest Leroux, 28, Rue Bonaparte, Paris, France.

Martinus Nijhoff, The Hague, Holland.

Otto Harrassowitz, Leipzig.

Friedlander Sohan Berlin.

In India.

The Manager, Imperial Book Depôt, Delhi.

Gulab Singh & Sons, Mufid-i-'Am Press, Lahore.

Manager, Punjab Law Book Depôt, Anarkali Bazar, Lahore.

Rama Krishna & Sons, Book-sellers and News Agents, Anarkali Street, Lahore.

Honorary Secretary, Punjab Religious Book Society, Anarkali, Lahore.

M. Abdul Aziz, Manager, The *vakil* and Roze Bazar Electric Press, Amritsar.

L. Labhu Ram, Book-seller, Ludhiana.

N. B. Mathur, Superintendent and Proprietor, Nazir Kanun Hind Press, Allahabad.

D. B. Taraporevala, Sons & Co., Bombay.

Thacker, Spink & Co., Calcutta and Simla.

Newman & Co., Calcutta.

R. Cambray & Co., Calcutta.

Thacker & Co., Bombay.

Higginbothams, Limited, Madras.

T. Fisher Unwin, Calcutta.

V. Kalyanaram Iyer & Co., 189, Esplanade Row, Madras.

G. A. Natesan & Co., Madras.

Superintendent, American Baptist Mission Press, Rangoon.

A. H. Wheeler & Co., Allahabad.

The Manager, "Hitavada," Nagpur Central Provinces.

REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB.

For the year ending 30th June 1922.

PART I.

ROYAL ASIATIC LIBRARY OF THE BOMBAY BRANCH OF THE

Lahore:
Printed by the Superintendent, Government Printing, Punjab.
1922.

INDEX.

		Pages.
Director's Report.—Section I.—Intra-departmental activities ...		1—9
" " "	Do. II.—The need of further facilities for research, and financial obstacles ...	9—13
" "	Do. III.—Notes on current problems...	14—22
" "	Do. IV.—Personnel ...	23—24

DIAGRAMS.

I.—Showing the areas of Punjab, American and Desi cottons in the Punjab from 1915-16 to 1922-23.	Facing page 14
II.—Showing the yields of Punjab, American (4-F), (285-F) and Desi cottons at Lyallpur Experimental Farm from 1915-16 to 1921-22.	Facing page 16
III.—Showing the yields of Punjab American (4-F), (285-F) and Desi cottons at Hansi Experimental Farm from 1915-16 to 1921-22.	Facing page 16
IV.—Showing the yields of Punjab American (4-F), (285-F) and Desi cottons at Sargodha Experimental Farm from 1915-16 to 1921-22.	Facing page 16

ANNEXURES.

I.—List of Agricultural schemes requiring financial support. ...	25—30
II.—Statement showing number of applications for admission to the Agricultural College and number admitted during the last 5 years ...	31
III.—Statement showing the results of the College examinations from the year 1914 onwards ...	31
IV.—Statement showing disposal of Silkworm seed imported during the last 5 years ...	32
V.—Profit and Loss Account of wheat seed depôts in the Punjab for the year ending 31st March 1922. ...	32
VI.—Profit and Loss Account of cotton seed depôts in the Punjab for the year ending 31st March 1922 ...	33

VII.—Statement showing sowings of wheat (Punjab-11 and 8-A) in Canal Colonies in the Punjab ... 33

VIII.—Statement showing sowings of cotton in canal-irrigated areas in the Punjab ... 35

IX.—Statement of cotton auctions held by the Agricultural Department during the year 1921-22 ... 37—39

X.—Statement showing the sale of imported implements during the last five years ... 40

XI.—Statement showing sale of implements manufactured by the Agricultural Department ... 40

XII.—Statement showing the purchases of wheat seed in seed depôts in the Punjab in 1922 ... 41—42

XIII.—Statement showing the purchases of cotton seed in seed depôts in the Punjab in 1922 ... 43

APPENDICES.

I.—Report of the Principal, Punjab Agricultural College ... i—vi

II.—Report of the Economic Botanist to Government, Punjab ... vii—xi

III.—Report of the Agricultural Chemist to Government, Punjab ... xii—xiv

IV.—Report of the Entomologist to Government, Punjab ... xv—xx

V.—Report of the Agricultural Engineer to Government, Punjab ... xxii—xxvii

Statement A.—Well Boring ... xxviii

Statement B.—Details of strainers used in wells in the Punjab ... xxix—xxx

VI.—Report of the Professor of Agriculture, Lyallpur, on District Work xxxi—xxxviii

VII.—Report of the Deputy Director of Agriculture, 1st Circle, Gurdaspur, on District Work ... xxxix—l

VIII.—Report of the Deputy Director of Agriculture, 2nd Circle, Hansi, on District Work ... li—lxiv

Review on the Annual Report on the Department of Agriculture, Punjab, for the year ending 30th June 1922.

Proceedings of the Punjab Government (Ministry of Agriculture) No. 491-50-K., dated 14th March 1923.

READ—

Letter No. 6218, dated 20th November 1922, from the Director of Agriculture, Punjab, forwarding the Annual Report on the operations of the Department of Agriculture in the Punjab for the year ending 30th June 1922.

1. The number of applicants for admission to the Agricultural College at Lyallpur was a record. The type was as good as last year. Unfortunately owing to want of accommodation not more than the usual number could be admitted. The proportion of agriculturists was much the same, 43 out of 53 admitted. The number of candidates for the B.Sc. (Agriculture) degree was 27 as against 11 last year. Of these, 14 passed and 10 have to re-appear in one subject only. Out of 36 candidates for the first Examination in Agriculture at the end of the second year course, 33 were successful and 10 out of 17 candidates obtained the 2-year Leaving Certificate. The whole vernacular class of 24 (17 of whom were sons of Punjab farmers) passed the final test. The men selected for the Teachers' class acquitted themselves well and all qualified to take up on their return the task of spreading a knowledge of agriculture in vernacular schools. A new feature at the College was the series of popular lectures by Messrs. Calvert and Darling, I.C.S., and Mr. Smith, the Imperial Dairy Expert, which were well attended and much appreciated. A resident Sub-Assistant Surgeon has been appointed to look after the students' health. Mr. Milne and his staff are to be congratulated on a successful year's work.

2. The Economic Botanist reports that last year's conclusions as to the superiority of 8-A. wheat were confirmed by further tests. This wheat is rapidly increasing in popularity. It is ousting Punjab-11, as it produces more grain and more straw. The remarks of the Gurdaspur Deputy Director about a gradual change in the colour of its grain are important.

A valuable propaganda was started on the subject of the cure for earcockle which does an immensity of damage, but can be eradicated practically without cost.

The fate of American Cotton is apparently still in the balance. Three disastrous seasons seem to have caused a radical and systematic deterioration in the quality of the fibre. The

extracts from correspondence quoted by Mr. Jacob show that the commercial community has been quick to notice the change. The Economic Botanist is inclined to ascribe it to insufficient supply of water at the right season, but will not condemn this cotton till the effect of the present better season can be seen. Meanwhile Desi cotton has been regaining popularity. The staple is shorter, but the yield is greater, and it does better in dry soil. In fact, it appears that American cotton has not yet been properly acclimatized and the whole situation seems to lend support to the theory that it is better to improve an indigenous than to introduce a foreign type.

Further endeavours were made to improve the quality of the hill potato crop. The Economic Botanist gives surprising figures of the enormous comparative yield of the Scotch varieties. The latter, however, have not yet stood the test of time. Similar high yields were given by imported Scotch and French varieties of oats; but here too it is early to pronounce definitely in their favour. The experience of the Department in American cotton teaches caution.

The date crop in the South-West was not as good as usual, but the coming crop is a heavy one. The demand for young plants is as keen as ever.

The necessity for improvement in the fodder crops was noticed in last year's review. The Department has not yet been able to devote much attention to this line, but the Ministry of Agriculture trusts that it will not be long delayed.

3. In the Punjab the special problems in the Agricultural Chemist's Department arise from the spread of alkaline and saline deposits. Various methods of reclamation are being tried, such as scraping and flooding, though no definite success has yet been reached. Mr. Lander considers the results hopeful. The account of the research work on the Bara Reclamation Farm in the Montgomery District are not hopeful and the prospect of obtaining an economic yield from bara land appears to be as far off as ever. Investigations into green manuring and sullage disposal were carried further, though no conclusions are yet reported.

4. The report of the Government Entomologist complains of the constant conflict between research and demonstration in the demands on the time of an insufficient staff. Commendable energy was, however, shown in both branches of activity. The list of publications given in the Entomologist's report is creditable to the staff. M. Afzal Hussain makes out a strong plea for legislation to compel farmers to carry out the simple precautions advocated by the Department for the destruction of the moth-

borer, which is reported to cause enormous loss particular in fodder supplies, to sugarcane, maize and jowar.

There was a large increase in the amount of silk reared this year only prevented by early hot winds from being something of a record. It is reported that insufficiency of staff has compelled the Department to curtail its activities in fostering this growing industry.

5. The year under report saw Mr. Miller Brownlie back from long leave, and his fertility of invention is reflected in the report on the Agricultural Engineering section. The workshop has been overhauled and its machinery re-arranged and it only requires electric power to be thoroughly efficient and self-contained. The failure of the Lyallpur electrical scheme was therefore particularly disappointing.

The efforts to discover a suitable power-boring machine which is expected to reduce the cost of well-boring to less than half that of hand-boring appear to have materialized at last and the discovery is an event of importance. With this and the new stoneware strainer of which the success is apparently assured, well-boring should be revolutionized. The pay and perquisites of the well-boring staff have been increased. The whole system is being examined with a view to making it remunerative and in the meantime the imposition of a small overhead charge has been authorised which should serve to make it very nearly self-supporting.

The persistent high prices of plant and machinery are still delaying the development of tube wells. A large scheme for sinking these wells over a considerable tract of Government waste near Jhang is at present under consideration by the Agricultural and Electrical Engineers. It is proposed to economize by a central power station and if the scheme is successful and can be made to pay, it should be the forerunner of private co-operative effort on similar enterprises.

6. The district work of the Department was prosecuted with the usual energy and enthusiasm, and the reports from the three main centres, Lyallpur, Gurdaspur and Hansi, make interesting reading. A discovery of outstanding merit will no doubt spread like wildfire, but the popularization of the numerous minor improvements, which have no startling qualities but which are nevertheless of the greatest value to the agricultural industry, is an uphill and unexciting work. Progress is, however, undoubted. A considerable impetus was given by the successful exhibition at the big Mela at Lahore on the occasion of the visit of His Royal Highness the Prince of Wales in February 1922.

The continued postponement of the establishment of a Deputy Director's Circle for the South-West Punjab owing to want of funds is a serious obstacle to progress in this backward part of the Province. Difficulties have arisen in the selection of a site for a Departmental Farm without which little can be attempted. Endeavours are being made to discover a suitable area in land already the property of Government.

7. In the supply of pure seed the Department finds one of its most beneficent activities. There are seed depôts at Lyallpur, Montgomery, Gurdaspur and Hansi, which shew for the year a profit of Rs. 41,366 over wheat and a loss of Rs. 8,646 over cotton transactions. It is not certain, however, that the accounts given in annexures V and VI include the cost of Establishment employed at the Depôts. The volume of business could be infinitely expanded and, as suggested by Maulvi Fateh-ud-Din, it might be possible to enlist private and co-operative enterprise.

Depôts for the sale of Agricultural implements have been established at Lyallpur and Gurdaspur. A third will now be started at Hansi. Sales fell off during the year partly owing to the high prices of the articles and partly to railway booking difficulties. The latter trouble has now been surmounted.

8. Apart from the purely experimental departmental farms at Lyallpur, Gurdaspur, Hansi and Kahuta, to which commercial considerations do not directly apply, the Department controls its own farms at Sargodha, Montgomery, Chillianwala and Beas and District Board Farms at Sialkot, Jullundur, Rohtak, Gujrat, Ludhiana and Raewind where the commercial aspect of the application of departmental methods can be demonstrated. It is hoped to add shortly to the list similar Government farms at Hansi and at Lyallpur and to add to the area of the Sargodha farm. It is essential that the accounts of all these farms should be kept on commercial lines and the system in force at the Hissar Cattle Farm would appear to be suitable. From the accounts given by Mr. Jacob of two District Board Farms and the Khalsa College Farm at Amritsar it would appear that none of these farms is at present commercially profitable. The chief reason for this unfortunate result no doubt is that the areas of the farms are at present too small so that the overhead charges represented by the cost of the trained staff, which could equally well supervise a greater area, are too high. Efforts should therefore be made to increase the size of the farms and for this purpose it is not essential that the whole farm should be within a ring fence. It is not many landholders however who have the minimum amount of land at their disposal which is necessary to justify the employment of expensive trained staff. It is there-

fore the desire of the Ministry of Agriculture that at these agricultural farms a part should be set aside as a model farm where, by the development of intensive agriculture and such subsidiary occupations as poultry and bee-keeping, fruit growing and dairying, the possibilities of increasing the economic return of the small holding may be demonstrated.

9. The Ministry of Agriculture desires that attention should be given to the important problem of the improvement of vegetables, fruits, flowers and garden produce, and considers that there is much scope for research in this direction. It is possible that existing pleasure gardens might be utilised to this end. A proposal to appoint a specialist in these subjects has been received from the Director of Agriculture but for the present the Director has been instructed to have existing conditions surveyed and reported upon in order to provide a basis upon which a decision can be arrived at as to the direction in which future progress can best be achieved. The Ministry trusts that the report will not be delayed.

10. The Departmental reports are forwarded with an original and interesting note by Mr. Jacob in which he subjects the aims and methods of the Department to searching and illuminating criticism. He stresses the position that the foundation of the work of the Department should be research and in this he is supported by Mr. Milne. The Ministry of Agriculture agrees that the secret lies in the proper correlation of research and demonstration, but would point out that the application of this principle lies in the hands of the Director whose advice in this respect Government has always been ready to follow, and to whose Department Government has been more than generous. The figures given by Mr. Jacob show that the Agricultural allotments have risen sixfold in the last ten years from 4 lakhs in 1911-12 to 24 lakhs in 1920-21. Nor in view of the continuous rise in expenditure can Government fairly be accused of feverish alternatives of generosity and parsimony. The variations from budget allotment will on inquiry probably be found to be due to unexpected variations in the building programme.

11. That Mr. Jacob's proposal for the formation of Research and Development Funds is in the present state of Provincial Finances quite out of the question and is not in accordance with the principles of Finance at present accepted in India, is not a complete refutation of the scheme. It is, however, open to question whether the present system has led to the frittering away of large sums of money on objects which seem likely to give an immediate return at the expense

of more important requirements of research. Lyallpur itself is proof that the requirements of research have not been neglected. Even if there were no other departments of Government with growing requirements the realization of demands for Research and Development involving an expenditure of Rs. 16 lakhs and Rs. 26 lakhs in capital and Rs. 5¼ lakhs and Rs. 4½ lakhs of recurring expenditure would be sufficiently difficult of achievement. But the enumeration of the items of demand serves a useful purpose and will focus the attention of the Ministry of Agriculture on the requirements of the Department.

12. Sanction was given during the year to six new Imperial appointments, *viz.*, second Economic Botanist, second Agricultural Chemist, Bacteriologist, Soil Physicist, Associate Professor of Agriculture, and second Agricultural Engineer. The Associate Professorship has been filled by one of the three Punjab Provincial Service officers whose elevation to the Imperial Service was sanctioned by the Secretary of State at the beginning of the year. The filling up of the remainder has been unavoidably delayed by the financial stringency. Two new posts were added to the Provincial Service during the year and the appointments made. The staff of Muqaddams was put on a time scale during the year and their pay and prospects improved.

The work of the Department was distinguished as usual by energy and enthusiasm, and was attended by an encouraging measure of success. The Directorship was held for all except the last month and-a-half of the year by Mr. Townsend, who handed over charge to Mr. Jacob on 16th May 1922, on going on 7 months' leave. The Punjab Government (Ministry of Agriculture) is indebted to the Director and his staff for an exceilent year's work.

ORDER:- Ordered that a copy of these remarks be forwarded to the Director of Agriculture, Punjab for information, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India, in the Department of Revenue and Agriculture.

By order of the Punjab Government
(Ministry of Agriculture),

E. R. ABBOTT,

Financial Commissioner and Secretary to Government, Punjab, (Development Department).

248 FC—577—21-3-23—SGPP Lahore.

No. 6218.

FROM

D. MILNE, ESQ., I.A.S.,

Offg. Director of Agriculture, Punjab,

TO

THE FINANCIAL COMMISSIONER AND
SECRETARY TO GOVERNMENT, PUNJAB.

Dated Lahore, the 20th November 1922.

SIR,

I HAVE the honour to forward herewith 9 advance copies of Part I of the Annual Report of the Punjab Agricultural Department for the year ending 30th June 1922.

I have the honour to be,

SIR,

Your most obedient servant,

D. MILNE,

Offg. Director of Agriculture, Punjab.

248FC—217—21.3.23—SGPP Lahore.

Annual Report of the Agricultural Department, Punjab, for 1921-22.

SECTION I.—INTRA-DEPARTMENTAL ACTIVITIES.

La Critique est la vie de la Science.

Changes of officers.

MR. TOWNSEND proceeded on 7 months' leave on the 16th May 1922, when I took over from him as Director of Agriculture, that is to say, I have officiated for 1½ months of the year under report.

Mr. Wilsdon, Agricultural Chemist, who had been on leave since 17th March 1921, reverted to the Education Department. Mr. T. A Miller Brownlie, Agricultural Engineer, returned from leave on 27th July 1921, Sardar Sahib Kharak Singh (now Associate Professor) returned from his studies in England on 19th December 1921 and Lala Madan Mohan Lal, Assistant Professor of Entomology, on 15th February 1922 The last named officer has again proceeded on medical leave from 28th June 1922.

Malik Sultan Ali and Sardar Darshan Singh continued to hold charge of their respective circles. The former for the whole of the year and the latter only up to 22nd December 1921 when he proceeded on 8 months' leave out of India, and was succeeded by Khan Sahib M. Fateh-ud-Din.

It is gratifying to note that the Secretary of State for India sanctioned the promotion of Sardar Sahib Kharak Singh, Khan Sahib M. Fateh-ud-Din and Chaudhri Muhammad Abdullah, officers of the Provincial Service, to the Indian Agricultural Service from 29th October 1921. In addition to this the following new posts were sanctioned for the Department during the year under report :—

(1) Second Economic Botanist.
(2) Second Agricultural Chemist
(3) Bacteriologist.
(4) Soil Physicist.
(5) Associate Professor of Agriculture.
(6) Second Agricultural Engineer.

On promotion to the Indian Agricultural Service, Sardar Sahib

Kharak Singh was appointed as Associate Professor of Agriculture and Khan Sahib M. Fateh-ud Din and Chaudhri Muhammad Abdullah as Deputy Directors of Agriculture against the 3 posts of Deputy Directors of Agriculture added to the Department in 1920, which had not been filled up. The third vacancy was filled up by Mr. D. P. Johnston, transferred from the Province of Behar and Orissa on 16th January 1922. The post of the sixth Deputy Director *vice* Mr. O. T. Faulkner, who is now Director of Agriculture, Nigeria, as also the other newly sanctioned posts in the Imperial Service, are still vacant.

Two posts in the Provincial Service were added to the Department during the year. One that of the second Assistant Professor of Agriculture aud the other of the second Assistant Professor of English. The former was filled up by Sardar Labh Singh, L. Ag,. on 19th December 1921, and to the latter Mr. Das Gupta, M. A., has been appointed on 20th July 1922.

The vacancy in the Provincial Agricultural Service caused by Khan Sahib Maulvi Fateh-ud-Din's promotion was filled up by M. Mukhtar Nabi, L. Ag., with effect from 3rd January 1922. The other two vacancies in the Provincial Agricultural Service were not filled up during the year. The new posts of twelve Agricultural Assistants and other subordinate posts in the Agricultural College asked for in 1920 were sanctioned by Government during the year, and incumbents have been appointed

Preliminary.

2. The results of the normal working of the Department will be found in the reports of the officers concerned, and some of the cruder aspects of the work are displayed in the tables attached at the end of my own report. In this report I propose to break with tradition, more especially because there appears to me grave danger that the Department may settle down into a routine (whether of actual stagnation or of superficial hustle makes no difference) in which the work of research towards a distant, but secure aim, will have no place.

The past and present.

3. To disciples of M. Coué past reports of the Agricultural Department must have seemed eminently satisfactory. Every day and in every way the Department was growing better and better. The latest wheat or the latest cotton was always an advance on its predecessor, new implements were sold in their hundreds, agricultural assistants were multiplied, and on many plots and farms the benefits of the new methods were 'demonstrated' to the people.

Government bestowed its paper eulogies freely on the experts of the department and on the Director. Even I, so strong had tradition become, received some commendatory phrases.

But of the critical spirit, with a few notable exceptions, there has been very little. For the most part the tests of outturns of the different varieties of crops were made on a number of duplicate fields quite inadequate to prove (within stated limits of probability, that the differences observed were systematic, and not due to genetic or environmental variation : the agricultural assistant sent out to advise farmers had often such little practical knowledge that the zemindar looked on him in much the same light as the hard-bitten campaigner looks on the 'arm-chair strategist': while the demonstration farms at their best usually demonstrated little except that a great increase of labour and money could produce a slight increase of the return, while at their worst they showed how money could be spent without any increased return whatever.

Now, so far from altogether finding fault with this want of critical judgment, it may safely be asserted that few, if any pioneering enterprises can reach a successful issue, if their creators are deterred by excessive forebodings. Indeed how few of us would be alive to-day if our parents had been endowed with a highly critical faculty towards their offspring. The pioneer likewise must deal tenderly with his own creation.

The future.

4. The time has now arrived, however, when all this must be changed. Either the Department is to advance, or it is to fail altogether. If it once sinks to the level of a routine department, employing so many Agricultural Assistants each year, carrying out year after year inconclusive tests on various plants and on various methods of cultivation, here and there, as the result of fortune or accident, progress may be made.

We want, however, to make progress inevitable, and this can only be done by far greater attention to research than has been paid in recent years. Too much attention has been given and too much money has been spent, in my opinion, on the demonstration of results which have not been scientifically established. This is a serious mistake, and I wish to emphasize as strongly as I can that the salvation of the Department must come by research, and by research only. The Platonic dictum that men will follow the good if they see it, is as true now of the Punjab zemindar, and of new agricultural methods, as it

was of the morals of Greece 23 centuries ago. That this is not a mere doctrinaire view is proved by the rapid spread of American cotton in the canal colonies, where demonstration, under the wise guidance of Mr. W. Roberts, had always been reduced to a minimum.

Some basic problems.

Now it might be supposed that the answer to the question 'what results do we hope to attain by research' is so obvious that the question it self is superfluous. But is it? It is true that the immediate answer is that we wish to secure bigger profits from farming, and that, in general, these bigger profits are to be obtained by discovering crops which are higher yielders, or are more resistant to lodging, to insect pests, and fungoid disease. Now, surely, if we propose to set about increasing the yields of the cultivators' crops, we ought first to have an accurate knowledge of what yields the cultivator gets at present from these crops. If the Department is going to boast in future years that it has made two blades of wheat grow where only one grew before, it assuredly will rightly be called on to prove what the yields of zemindari fields were before it started its beneficent work. No one who has any knowledge of the methods at present adopted in ascertaining the yields of crops on cultivators' land, would venture to assert that we know these yields within 15 to 20 per cent., and yet it would be an achievement to raise the yield of wheat, say by one maund per acre throughout, that is, by no more than 10 per cent. The methods I have proposed for rapid crop-yield tests would enable the existing yields to be determined with an accuracy of, say, 2½ per cent., and, for a beginning, this may be regarded as a sufficiently close approximation. The immediate steps to be taken, therefore, as a preliminary to the expansion of research work (which I shall deal with later), are :—

The determination of yield of crops under ordinary farming conditions.

(*a*) To determine by crop tests, made in hundreds by a combined motor-reaper and thresher, the actual yields of various cultivators crops from year to year, and to calculate the correlation of these yields with the relevant climatic factors, so that when comparing the results of one year or of one place in which old types of crop are grown, with the yield of new type crops, at another place or in another year, the seasonal and topographic variations may be eliminated.

I am confident that a suitable machine can be designed though, if so, it will have to be done either departmentally, or by

offering a large reward so as to make it worth while for commercial firms to take the matter up. No agricultural-implement firm has the right type of machine, nor, at present, can any firm be induced to treat the matter seriously. I trust I have made myself clear, but if not, then it is necessary to re-assert that the problem I propose is fundamental, and must be, and can be solved, if agricultural progress is to be measured, and not merely left to be assumed by ignorant and optimistic officials, and denied by pessimistic and equally ignorant critics.

The application of statistical tests to the experimental results on Departmental farms.

(*b*) In the second place it is necessary to examine the numerous varietal, cultural, hydraulic, manurial, and other tests, carried out in past years at the Agricultural Experimental Stations in order to determine whether precise deductions can be made therefrom. If it is found, as indeed is certain in respect of a large number of these tests, that the results are inconclusive, then, in those cases, the tests must be recast.

As to this, namely, the examination of the vast accretion of data, which now accumulates yearly in the Annual Experiment record which forms Part II of the Annual Report, it is palpably a waste of time to amass all this information unless it is carefully analysed, particularly in order to discover the spatial and temporal pecularities of crop yields. That the data would throw light on many problems which are important seems probable, that they would show whether existing cropping schemes are of the right kind is certain. Yet, so far as I know, the only attempt made to draw general conclusions from the recorded results of the experimental farms in the Punjab is Mr. Faulkner's note on the effects of manures. Even this investigation did not profess to ascertain to what extent climatic conditions or the original mechanical and chemical constitution of the soil modify the beneficial effects of manure.

Frankly, I think that there is a great deal of laboriously gathered information going to waste—and that means money wasted too—simply because statistical expert knowledge is not employed to collate the results obtained, and to guide the experimenter. The task is certainly not lightly to be undertaken in the intervals of considerable routine duties. I have sketched the beginning of such an enquiry, however, in relation to American cotton, as the problem of its diminished yield since 1919 is too serious to be ignored, and even Mr. Milne's brilliant reports on

the subject do not include a systematic comparison of all available data from the experimental farms.

I also attach a table (Table I) showing the number of independent duplicate adjacent plots necessary to establish with a probability of 30 to 1 (Professer T. B. Wood's criterion) the significance of an ascertained increase of yield of one type of cotton as compared with another. The correlation of adjacent plots is taken as 0·7, a result which is about the average found by Faulkner and myself from Lyallpur data. Until the lesson enforced by these figures is learnt, it is impossible for the deductions made from varietal and other kinds of crop tests to be anything but confusing and contradictory :—

TABLE I.

Showing the number of duplicate plots to be sown with each variety of crop in order to establish that a given superiority of mean yield is not due to chance, with a probability of 30 *to* 1.

	Observed difference in mean yield between the two varieties.	*Number of plots required to establish a genuine superiority when the plots are—*	
		(*a*) adjacent.	(*b*) non-adjacent.
I.—Cotton. ...	20 lbs.	363	1,211
	40 „	91	303
	60 „	40	135
	80 „	23	76
	100 „	15	48
II.—Wheat ...	20 lbs.	1,096	3,654
	40 „	275	916
	60 „	122	406
	80 „	69	229
	100 „	44	146

The reason that wheat requires a larger number of comparison plots for a given absolute difference of yield is that its variability, as measured by its standard deviation, is considerably greater than that of cotton, the mean of the results of all years from 1912 to 1919 at Lyallpur being standard deviations of 230 lbs.

and 400 lbs. for cotton and wheat, respectively. The correlation between adjacent plots is, as before, taken as 0·7.

I am afraid the conclusion to be drawn from this table is that the majority of the field tests carried out at the Punjab experimental farms have far too few comparison plots, and are therefore unlikely to lead to sure conclusions, except when the differences in yields are very large, larger in fact than can be hoped for in ordinary 'selection' work. Even in plant-breeding work on Mendelian lines an increased yield of 80 lbs. per acre would be something of a windfall.

Looking at the matter in another way, if we are advancing the yields by 5 per cent steps, corresponding to increases of about 40 lbs. of unginned cotton, and to about 80 lbs. of wheat, we should use 70 to 90 adjacent plots for each of the two types which are being compared. If this seems a hard saying to agricultural officers, then I must remind them that most scientific investigations meet what seem to be insuperable difficulties at the time. The only ways out of the dilemma, if dilemma it is, so far as I can see, are—

(*i*) to reduce soil heterogeneity so that the variation of the cutturn from field to field is reduced below the 30 per cent., which shows itself hitherto in long series of tests at Lyallpur, both for wheat and cotton ;

(*ii*) to raise the correlation of adjacent plots by using long narrow strips.

There are obvious limitations to the employment of these 2 remedies, and, according to one authority,* the methods would appear to be in partial antagonism to each other.

Commercial aspect of demonstration farms.

(*c*) Lastly, we have to consider more closely than has been done hitherto the results of the applications of the departmental methods in their business aspects. In regard to the use of improved varieties, the added yield can be put down as almost pure profit: but in respect of new cultural methods, better implements, deeper ploughing, interculture, manuring, etc., the cost of material and labour must be set against the profits of increased yields. Likewise the possible economic employment of trained men must be considered. It is not only that these men

*J. Arthur Harris "Practical Universality of field Heterogeneity as a factor influencing plot yields." Journ. of Agric. Research, July 1, 1920.

must produce an increased return by scientific supervision, but this increase must pay for the increased overhead charges of which the chief items are the high salary and the better accommodation they demand for themselves.

It is not possible to deal with the question in detail, but the following account of income and expenditure on 3 of our chief Demonstration farms will perhaps throw some light on the problem :—

Receipts, 1921-22.			Expenditure, 1921-22.		
	Rs.	Rs.		Rs.	
			Depreciation at 3 per cent. on Buildings —		
Sialkot ...	4,717		Sialkot ...	26,000	
Amritsar ...	4,738		Amritsar	17,000	
Rohtak ...	1,979		Rohtak	12,600	
		11,434		55,600	1,668
			Depreciation at 10 per cent on bullocks and implements		
			Sialkot	4,020	
			Amritsar	2,300	
			Rohtak	3,160	
				9,480	948
			Interest on capital outlay including land at 5 per cent—		
			Sialkot	68,000	
			Amritsar	46,900	
			Rohtak	21,700	
				1,36,600	6,830
			Running expenses 1921-22—		
			Sialkot	4,623	
			Amritsar	3,738	
Loss ...		8,257	Rohtak	1,884	10,245
Total ...		19,691			19,691

This, of course, applies a severer test of efficiency than the facts warrant, and probably a vast number of actual cultivators farms would show a loss if they were debited with interest on the capital value of the land. Also the expenditure due to the salary of Agricultural Assistants is not altogether a fair charge, as they are strictly speaking only attached to the farms, and have to work very largely in the Districts. However, the results show that the farms do not pay their way at present, if looked at from a cold commercial view-point.

SECTION II—THE NEED OF FURTHER FACILITIES FOR RESEARCH, AND THE FINANCIAL OBSTACLES.

Solitudinem faciunt 'fiscam' appellant.

Agricultural Policy and Finance

5. I have dealt in section I with some of the work of research which forms a necessary foundation for a permanent structure of Agricultural knowledge. Now the Punjab Agricultural Department has at present no clear policy. Each expert presses for the expansion of his own section, and the needs of the Department as a whole are never considered in relation to financial exigencies. The blame must, I fear, be largely laid at the door of an antiquated administrative and financial system which is unfitted to cope with the problem of the right expenditure of money on scientific research. Financial experts in India are not scientists,* and it is unreasonable to expect them to decide between the relative merits of proposals which, having received administrative sanction, wait, sometimes for years, in the outer court of the financial 'Holy of Holies.' Why a particular proposal is finally admitted, to the exclusion of the others, into the innermost temple, must remain to the outsider an inscrutable mystery.

Equally with the system of sanction is the system of annual budget allotment unsuited to the developmental stages of a scientific department. It is impossible to plan a building unless one knows in advance how many bricks are to be made available altogether; and, as the final edifice will take many years in building, it would be advisable to tell the architect at once how much material he is likely to have at his disposal. He can then suit his design to his resources, and will not attempt to construct a cathedral from a tale of bricks which will only suffice to build a chapel-of-ease.

---

*A better appreciation of the commercial value, if not of the ideals of science, is perhaps to be hoped for from the brachycephalism of the Inchcape committee.

While, then, the system of annual budgets is unsatisfactory to the Agricultural Department, it can hardly be more satisfactory to the financier. I take it that the Finance Department intends that the annual budget should give it a close estimate of the annual expenditure. If this is so, then, the Agricultural budget estimates definitely do *not* fulfil the intentions of the Finance Department. This is made clear by the following table, showing the budget allotment and actual expenditure of the Agricultural Department for the 10 years 1911-12 to 1920-21 inclusive of major and minor works, excluding Veterinary expenditure (budget head 34-*c*) :—

Table II.

Financial Year.	Budget allotment.	Expenditure.	Difference.
	Rs.	Rs.	Rs.
1911-12 ...	3,91,883	3,88,860	+ 3,023
1912-13 ...	6,60,958	3,51,602	+ 3,09,356
1913-14 ...	8,72,676	4,75,452	+ 3,97,224
1914-15 ...	4,71,645	6,10,472	− 1,38,827
1915-16 ...	6,79,659	6,53,256	+ 26,403
1916-17 ...	5,75,399	7,00,140	− 1,24,741
1917-18 ...	17,59,654	8,24,616	+ 9,35,038
1918-19 ..	12,29,813	10,78,614	+ 1,51,199
1919-20 ...	21,27,674	14,27,821	+ 6,99,853
1920-21 ...	23,97,300	17,52,021	+ 6,45,279
otal ...	1,11,66,661	82,62,854	+ 29,03 807

Note.— + denotes excess of budget, — denotes excess of expenditure.

The table shows that whereas the budget allotment has shown feverish alternations of generosity and parsimony, the actual expenditure has proceeded steadily upwards, and the difference between the two has been so great, sometimes being even as much as 9 lakhs of rupees,* that clearly a grave defect of administration or financial policy, or possibly of both, is revealed.

* The average error of the budget estimates for the decennium is no less than 30·7 per cent.

I am bound to reiterate my own belief that the fault lies mainly with the system of the annual water-tight budget, which does not allow of the adoption of a far-sighted plan of development. The Director has been obliged to pursue a steady policy of expansion as best he can without regard to the violent year to year fluctuations of his budget.

Necessity for a development grant for research.

6. The result, therefore, of the working of the annual budget has not been satisfactory to the Department, and, in particular, it has led to the frittering away of what are, in the aggregate, large sums of money, on objects which seem likely to give an immediate return, such as the building of tube-wells, the purchase of seed, the financing of demonstration farms, the erection of seed stores, show-sheds, wings to veterinary hospitals and so forth. No doubt these are laudable objects of expenditure in certain conditions, but the upshot has been that the requirements of research, which necessarily produces only distant benefits to the country and the cultivator, have been disregarded.

Thus a Research Institute for the dry-farming and chahi tracts, at Jullundur, or Ludhiana, or Ambala, and an Irrigation Experiment station at Lyallpur, are crying necessities, and though it is almost useless to hope for them under the present system of doles, yet in the course of a few years, the money needed for either of these institutions is likely to be spent on all sorts of petty enterprises.

No less a sum than 30 lakhs of rupees has lapsed from the budget allotments of the 10 years 1911-12 to 1920-21. How much of this is due to rebudgetting on account of money not spent in any year, it would be almost impossible to find out, but it would probably be safe to estimate it at not more than one half the total amount. This leaves 15 lakhs, and if we add to this the sum which has been actually spent out of the Wheat Profits Grant, about 10 lakhs, it is seen that during the course of the 10 years, Government has allotted 25 lakhs for development purposes. Had the sum definitely been created as a trust fund for the development of Agriculture, it would have sufficed to build, equip, and to *endow* with over 1 lakh of rupees of annual income, either the dry-farming Research Institute or the Irrigation Experiment Station.

The first advantage of a trust fund is that important schemes stand their chance with a host of petty ones.

The second advantage of a trust fund is that it enables the Department to see exactly what sum it has at its disposal, and forces it carefully to weigh the relative merits of different schemes. Economies will be practised because if money is saved on one object it will be available for other agricultural objects. Under the present system a Head of Department who attempts to economise is more or less a fool, as the money is snatched away from him by the Finance Department, and is handed to another less scrupulous Department.

The third advantage of a trust fund is the correlative of the second, as the Finance Department will know where it stands. All the Finance Department knows, at present, is that the budget estimate is going to be stultified. Of course it would be quite easy to bring estimate and expenditure into agreement, on the present lines, by preventing any money being spent on development. That would indeed be peace at the price of solitude.

Specific proposal.

In annexure I of this report I give a list of various schemes, showing separately those which will provide for research, and those which are likely to be put forward as routine developments of departmental activities. The list does not pretend to be exhaustive (notably it omits reference to the proposals of the Sugar Committee); nor is it to be expected that money can necessarily be found for all the schemes incorporated in the list. What it does do, however, is to show what are the more important lines of work, and the approximate cost of each. When the development trust fund is created then the relative merits of each of the schemes can be carefully considered by the Department with reference to the total sum at its disposal. If the sum provided is sufficient only for some of these schemes during the next 10 years, comprehensive scrutiny will ensure that the money is spent on the most important objects, and that the big schemes will not continually be ousted by the petty ones, as unfortunately happens under the present conditions.

The sums required are :—

	Capital Rs.	*Recurring.* Rs.
17 Research schemes ...	16,50,000	5,50,000
56 Routine development schemes	26,00,000	4,50,000
Total ...	42,50,000	10,00,000

I propose therefore that two funds, a Research Fund and a Development Fund, should be formed. The amount proposed for these funds will be given below, but if they are created, one principle should be definitely laid down in respect of them, namely, that which was formulated by the Geddes' Committee in relation to the Development Fund of the Ministry of Agriculture and Fisheries, a fund which stood at £ 1,250,000 at the end of the financial year 1921-22. The Committee says * " We should like to draw attention to the fact that expenditure from the Development Fund does in fact result in recurring expenditure for future years, which cannot well be discontinued when the money granted from the fund is exhausted. We consider that it should be definitely laid down that future expenditure from the Fund or from the special grant of £ 850,000 should not entail any additional future expense to the State when the money noted is exhausted ; in other words, any expenditure involving future commitments should be endowed out of the Fund, otherwise Parliamentary control of expenditure is weakened." This seems to me a very wise provision, and it is on the application of this principle that I base my proposals.

The sums required to meet the capital expenditure, and endow (the endowments are calculated as giving a return of 5½ per cent) the recurring expenditure for Research and Development are approximately :—

	Rs.
Research	1,16,50,000
Routine Development ...	1,15,50,000
Total ...	2,32,00,000

This sum is slightly in excess of the development grant of Rs. 1,87,50,000 of the English Development Fund, though it is not out of proportion to the relative agricultural interests at stake, but it is probably beyond the present financial resources of the Punjab. I propose, therefore, that the very modest sum of 50 lakhs be provided during the next 10 years, to be divided equally between two Trust Funds for Research and Routine Developments, giving each Fund 25 lakhs. This sum is within the range of practical finance, and is not even double the amount which has been allotted to the Agricultural Department in the past 10 years, and has been allowed to lapse.

* *Vide* page 35 of the second Interim Report of the Committee on National Expenditure.

Section III.—Notes on current problems.

Punjab-American cotton.

7. The most striking achievement of the Punjab Agricultural Department since its inception has been the introduction of an apparently acclimatized variety of American cotton. With a staple of $\frac{7}{8}$"ths to 1" as compared with an average staple of about $\frac{5}{8}$" of desi cotton, 4-F American cotton fetched a considerable premium and, as up to the year 1918 its yield per acre was not lower than that of desi, it leapt rapidly into popularity with the Punjab cultivator. From the very small beginning of 300 acres in 1913-14 the area under 4-F rose in 1920-21 to no less than 700,000 acres in the Canal Colonies. In 1919-20, however, very poor yields were obtained; but, because high prices were obtainable for the limited amount of good cotton of that harvest, the falling off in area did not begin till 1921-22, then becoming very marked owing to the combination of low yields in 1919-20 and 1920-21, and the lower prices given for the 1920-21 crop.

The areas sown.

The actual areas of both the desi and American cotton are given in Annexure VIII of the report, for the years 1915-16 to 1922-23 inclusive, and though the separation of American and desi cottons was not made in Canal or Revenue records prior to 1921-22, the results may be accepted as approximate. The course of the areas sown to American and desi cottons respectively is shown on Diagram I, which also gives the January price of American Middling Fair cotton at Liverpool, which, except during the period of the intensive submarine campaign 1917-18 and 1918-19, is the main factor controlling the price of the Punjab cotton crop.

The percentage of the American crop in the Canal Colonies to the total crop for each year and Canal Colony separately since 1915-16 up to date, is given in the table below. The figures prior to 1920-21 are based on estimates which can only be treated as rough approximations :—

Table II.

Percentage area of American cotton to the total cotton crop in the various Canal Colonies for 1915-16 to 1922-23.

Year.	Lower Chenab.	Lower Bari Doab.	Upper Jhelum.	Lower Jhelum.	Other Canals.	Total.
1915-16	4	3	0	11	0	2
1916-17 ...	17	33	0	14	0	8
1917-18 ...	51	93	0	15	0	22
1918-19 ...	60	100	4	13	0	33
1919-20 ...	65	80	15	53	0	30
1920-21 ...	80	81	22	92	12	46
1921-22 ...	77	93	82	83	6	54
1922-23 ...	56	80	66	67	4	41

DIAGRAM I.

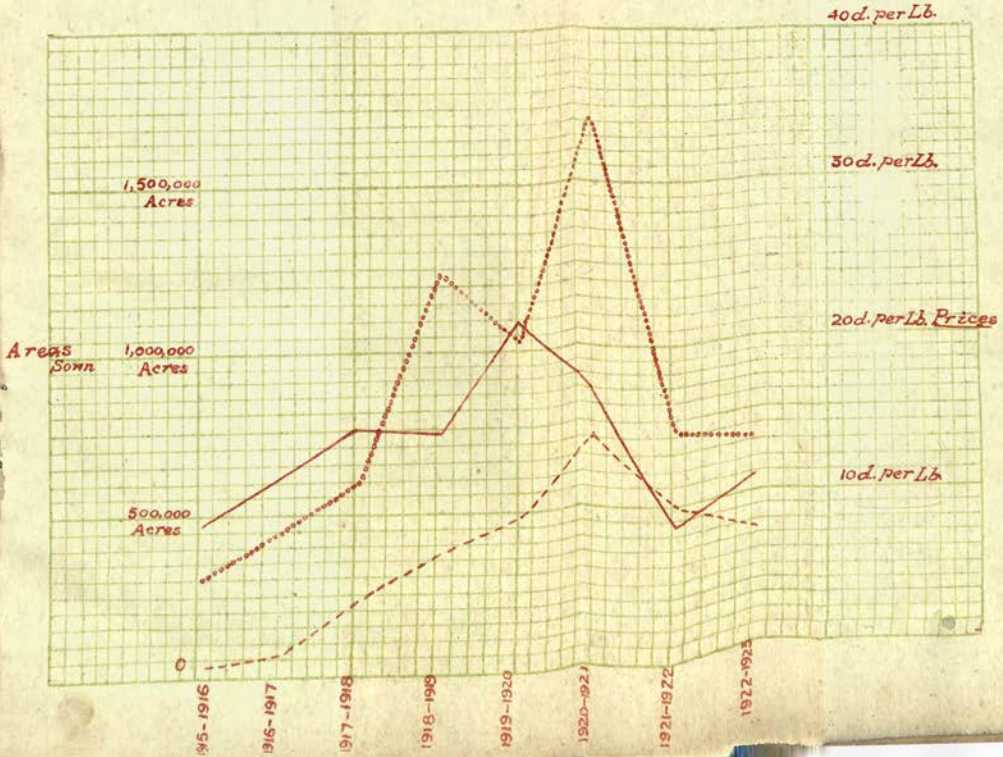
Diagram showing the sown areas of :—

American Cotton.....

Desi Cotton.....

and annual average price of American Middling Fair in Liverpool in January preceding sowing.

in the Canal Colonies of the Punjab.



Yields per acre.

The third important point on which the relative data have been collected for the years 1915-16 to 1921-22 is the yield per acre of unginned cotton. The outturn on cultivators fields are, as I have emphacized in Section I, a matter of conjecture. but I have collected all the records of yields obtainable from the returns of nearly 1,000 plots on the experimental farms at Lyallpur Hansi or Sargodha, on various types of desi cotton, and on 4-F and 285-F Punjab-American cotton. The results are tabulated in Table III below which enables a comparison to be made between the mean yield of Desi and American 4-F and 285-F cotton, and also gives an estimate of the degree of probability that the ascertained difference in yield between two varieties is due to chance. It will be observed that in the course of the 7 years from 1915 to 1921 inclusive, 4-F is demonstratively (using the same 30 to 1 criterion of proof that has been adopted in Section I) better than desis in 1915 at both Lyallpur and Hansi, in 1916 4-F is better at Hansi only. In 1917 it is better at Lyallpur, and again at Hansi in 1918. In the remaining places and years desis are almost always demonstratively better than 4-F.

Table III.

Statements of the comparative yields of American and Desi cottons at the Punjab Experimental Farms since 1915-16 to 1921-22.

Table III (a).

American 4-F and Desi.

Place.	Year.	Excess of American 4-F over Desi, in maunds.	Standard error of differences, in maunds.	Ratio of excess to standard error.	Probability that excess of 4-F American or Desi is due to chance.	
Lyallpur ...	1915	+ 2·325	0·77	3·01	1/500	4-F better.
Hansi ...	1915	+ 2·8	0·36	7·77	<1/1,000	„
Lyallpur ...	1916	− 1·05	0·56	1·61	27/500	Desi better.
Hansi ...	1916	+ 4·525	0·54	8·38	<1/1,000	4-F „
Lyallpur ...	1917	+ 1·525	0·77	1·98	3/125	4-F „

Table III (a)—concld.

AMERICAN 4-F AND DESI—concld.

Place.	Year.	Excess of American 4-F over Desi in maunds.	Standard error of differences in maunds.	Ratio of excess to standard error.	Probability that excess of 4-F American or Desi is due to chance.	
Sargodha ...	1917	− 2·15	0·87	2·47	7/1,000	Desi better.
Lyallpur ...	1918	− 3 95	0·48	8·23	<1/1,000	Desi „
Hansi ...	1918	+ ·725	0 34	2·13	17/1,000	4-F better.
Lyallpur ...	1919	− 1 025	1·04	0·98	41/250	Desi better.
Hansi ...	1919	− 0·675	0·41	1·64	51/1,000	Desi „
Lyallpur ...	1920	− 3·0	0·47	6 38	<1/1,000	Desi „
Hansi ...	1920	− 0·175	0·37	0·47	8/25	Desi „
Sargodha ...	1920	− 4 375	0 96	4·55	<1/1,000	Desi „
Lyallpur ...	1921	− 7·35	0·65	11·31	<1/1,000	Desi „
Hansi ...	1921	− 6·4	0·41	15·61	<1/1,000	Desi „
Sargodha ...	1921	− 5·025	1 12	4·48	<11/,000	Desi „
Khanewal ...	1921	− 2·775	0·26	10·67	<1/1,000	Desi „

Table III (b).

AMERICAN 4-F AND AMERICAN 285-F.

Place.	Year.	Excess of 4-F American over 285-F American in maunds.	Standard error of differences in maunds.	Ratio of excess to standard error.	Probability that excess of 4-F or 285-F American is due to chance.	
Lyallpur ...	1918	− 2·875	0·52	5·52	<1/1,000	285-F better.
Ditto ...	1919	− 1·6	0 51	3 13	1/1,000	285-F „
Ditto ...	1920	− 2·25	0·3	7·5	<1/1,000	285-F „
Ditto ...	1921	+ 0·95	+ 0·26	3·65	<1/1,000	4-F „
Hansi	1921	− 4·175	1 04	4·01	<1/1,000	285-F „
Sargodha ...	1921	+ 0·7	+ 1·35	0·51	61/200	4-F „
Khanewal ...	1921	+ 0·525	+ 0·72	0·73	233/1,000	4-F „

DIAGRAM II

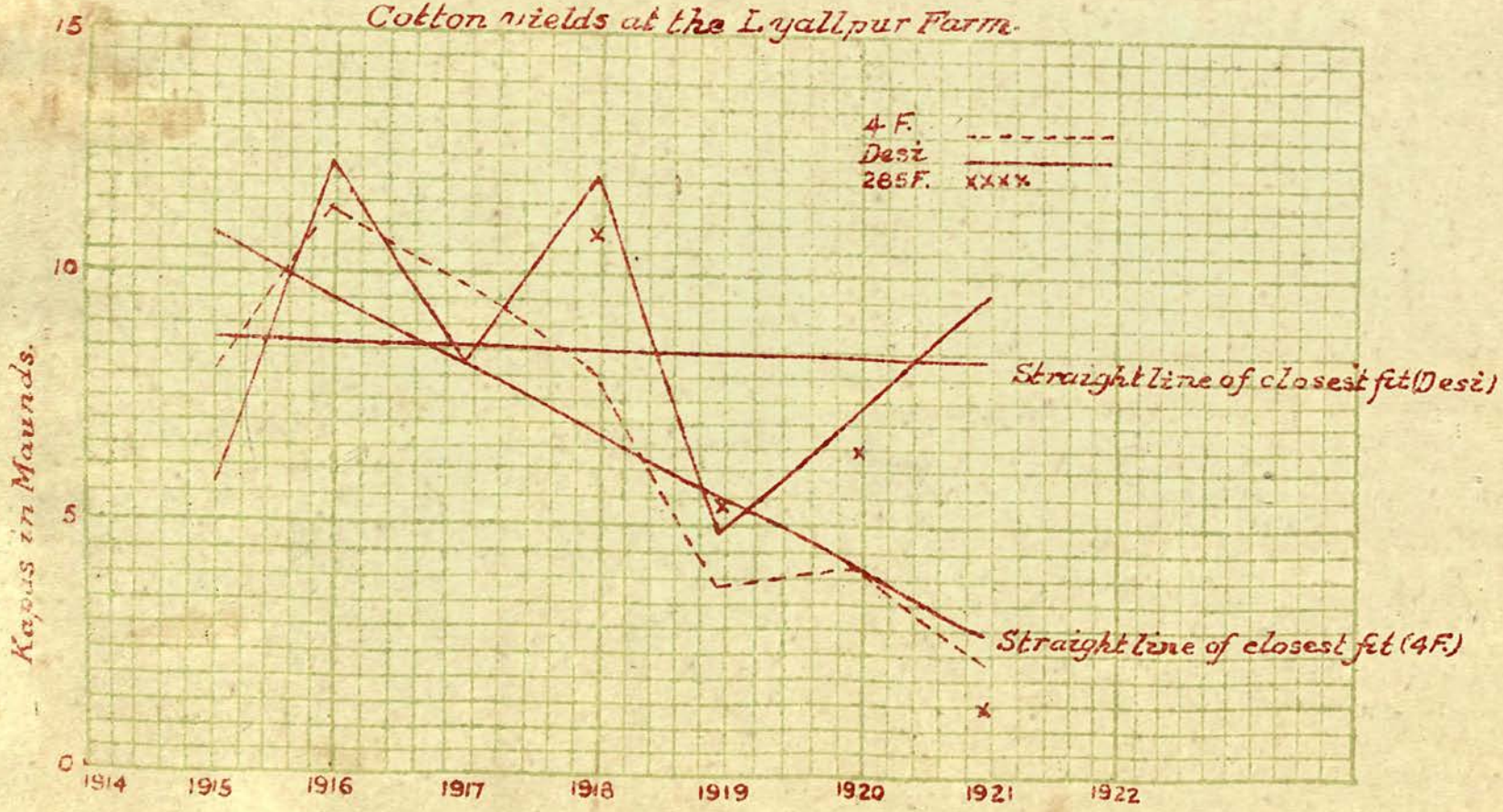

Cotton yields at the Lyallpur Farm.
4 F.
Desi
285 F.
Straight line of closest fit (Desi)
Straight line of closest fit (4F.)
Kapas in Maunds.
15
10
5
0
1914
1915
1916
1917
1918
1919
1920
1921
1922

DIAGRAM III

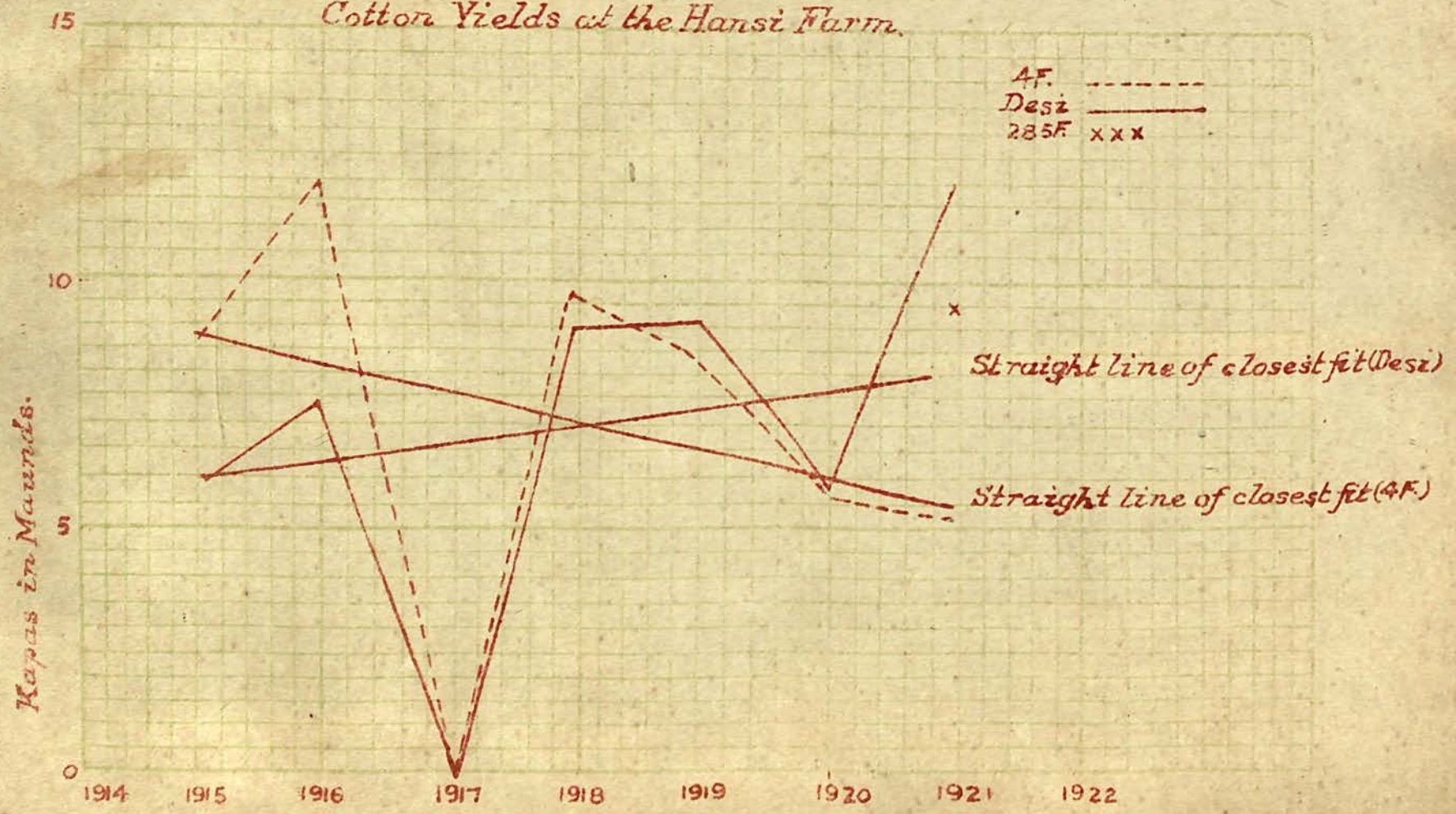
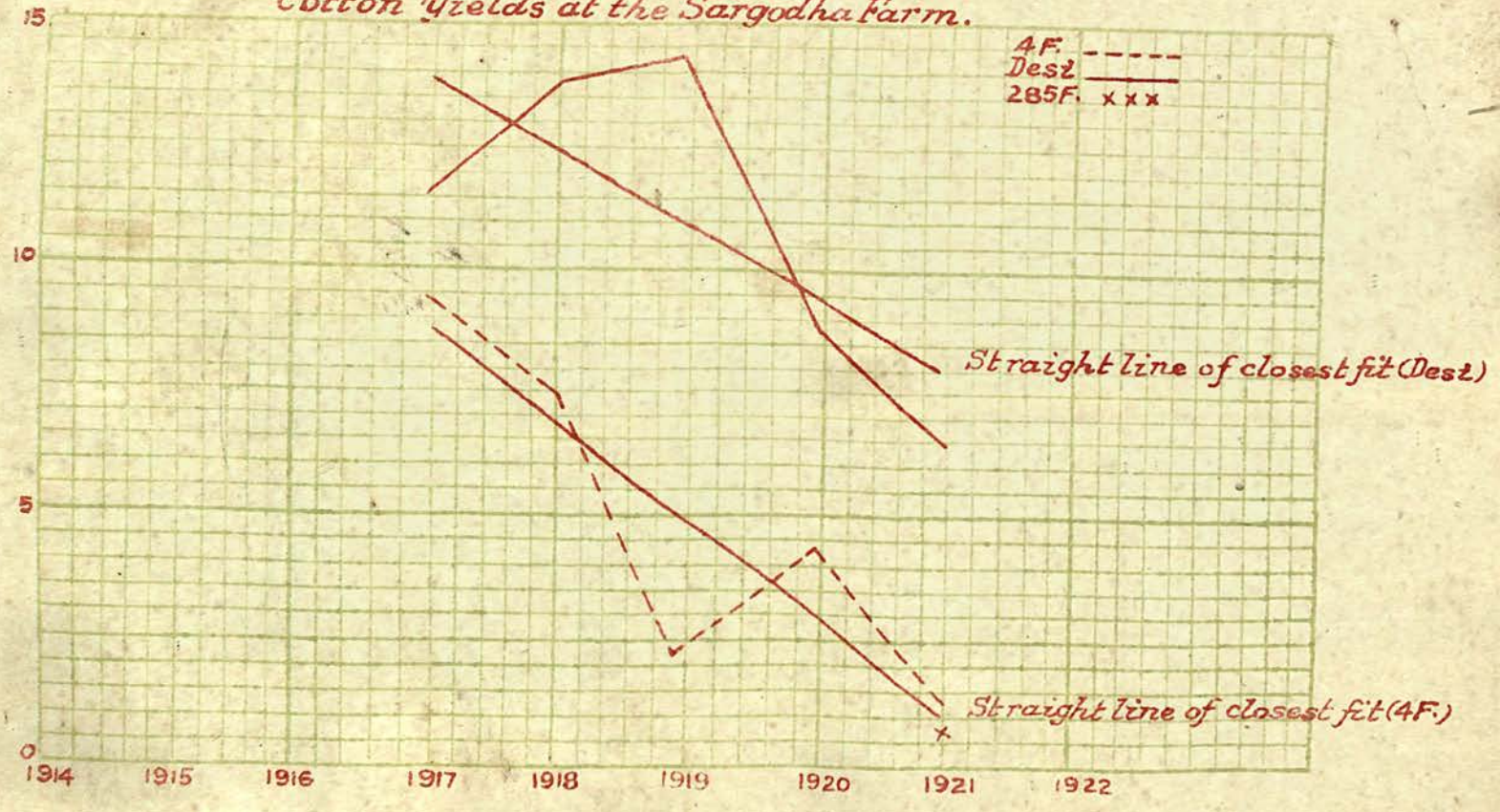

Cotton Yields at the Hansi Farm.
4F.
Desi
285F
Straight line of closest fit (Desi)
Straight line of closest fit (4F.)
Kapas in Mannds.
15
10
5
0
1914
1915
1916
1917
1918
1919
1920
1921
1922

DIAGRAM II

Cotton yields at the Sargodha Farm.



Kapas in Maunds.

TABLE III (*c*).

285-F. AMERICAN AND DESI.

Place.	Year.	Excess of American 285-F over Desi in maunds.	Standard error of differences maunds.	Ratio of Excess to standard error.	Probability that excess of 285-F American or Desi is due to chance.	
Lyallpur ...	1918	−1·075	0·67	1·60	11/20	Desi better.
Lyallpur E. B. ...	1918	−0·15	0·97	0·15	11/25	Desi
Lyallpur ...	1919	+0·575	1·15	0 5	31/100	285-F better.
Lyallpur E. B. ...	1919	−6·6	1·14	5·79	<1/1,000	Desi ,,
Lyallpur ...	1920	−0·75	0·52	1.44	3/40	Desi ,,
Lyallpur ...	1921	−8·3	0·68	12·20	<1/1,000	Desi ,,
Hansi ...	1921	−2·225	1·02	2·18	3/200	Desi ,,
Sargodha ...	1921	−5·725	1·17	4·89	<1/1,000	Desi ,,
Khanewal ...	1921	−3·3	0·85	3·83	<1/1,000	Desi ,,

The average yields from year to year are further shown in Diagrams II, III and IV, which also show the lines of closest fit by least squares of ordinate differences, for 4-F and Desi cottons separately.

Summary of economic facts.

The salient points as to the economic aspects of cotton cropping in the Punjab during the last 8 years, which are elucidated by the above statistics are :—

(1) 4-F Punjab-American cotton from a negligible area in 1913 became increasingly popular in the Canal Colonies, till in 1921-22 it formed no less than 54 per cent. of the cotton on all the Colony Canals, whilst in that year on the Lower Bari Doab no less than 13 acres out of 14 sown to cotton were Punjab-American.

(2) While the area of Punjab-American cotton was rising so fast up to no less than 700,000 acres in 1920-21, the area under Desi cotton was also undergoing an expansion in a smaller degree, consequent on the great rise in cotton prices during the years 1917-18 to 1920-21. The area under Desi cottons in the Colonies reached its maximum in 1919-20, when no less than

one million acres were under these types, commonly classed together under the trade designation of Scinde-Punjab cottons.

(3) The area under *both* 4-F and Desi cottons has markedly decreased in the last two years, once more in sympathy with the drop in cotton prices, and in the current year (1922-23 crop) 4-F has been sown on just over 350,000 acres, and Desi on just over 500,000 acres, this latter figure being about the area under Desi before the war-boom commenced.

(4) During the last five years the outturn per acre of unginned 4-F cotton has shown a general decline at all 3 Experimental Farms, indicative of diminished yields in the Canal Colonies of the Lower Chenab, Lower Jhelum, and in the Hissar District, respectively.

During the same period Desi cottons have, as judged by the yields on the Experimental Farms, been almost steady in the Lower Chenab Colony, diminished largely in the Lower Jhelum Colony, and increased in the Hissar District.

The actual average yields at the Experimental Farms, and the annual average rates of increase (+) or decrease (—), as shown by the line of closest fit are as follows:—

	Mean yields in maunds of unginned cottons.		*Annual rates of increase (+) or decrease (—) per acre in maunds of unginned cotton.*	
	4-F	Desi.	4-F	Desi
Lyallpur (1915-16 to 1921-22) ...	6·8	8·6	—1·34	—0·08
Hansi (1915-16 to 1921-22) ...	7·1	7·0	—0·53	+0·32
Sargodha (1917-18 to 1921-22) ...	5·0	10·9	—1·92	—1·50

Both in respect of its average yields, and its slow rate of diminution in yields, 4-F cotton at Hansi compares favourably with 4-F cotton at Lyallpur or Sargodha. These yields are based on results from many hundreds of crop tests, and are therefore subject only to a small probable error.

(5) Concomitantly with its diminution in yield there is evidence that 4-F cotton has undergone a deterioration of quality in fibre since the 1919/20 crop inclusive. This is a fact of which I have been assured by many mill-owners in different parts of the country, for example the Secretary of the Delhi Cloth and

General Mills, Mr. Mehta, of the Empress Mills, Nagpur, Mr. Stones, of the David Sassoon Mills, Mr. McKee of Messrs. Chrystal and Co., Cotton Brokers, Bombay, and Mr. Horsman of the Swadeshi Cotton Mills, Cawnpore. With this strong consensus of disinterested opinion the conclusion seems unavoidable, though when the actual results were obtained from the mills of spinning counts and strength, the figures did not confirm the statements. The reason for this is, doubtless, as explained by Mr. B. C. Burt and Mr. Mehta, that mills only obtain cotton that is suitable for the yarn they wish to spin. If cotton is poor it is merely rejected, and does not come into the mill spinning tests, which therefore only give a record of cotton that is *prima facie* up to standard. The tests samples from the mills cannot, therefore, be regarded, in any sense, as representative of the average spinning value of the crop This emphasizes how important it is to have a cotton technologist to carry out tests on random samples of cotton supplied by the Agricultural Department itself.

8. To show how seriously this deterioration is regarded by the trade I quote from some of the letters received from the various sources. Mr. Horsman, Swadeshi Cotton Mills, Cawnpore, writes :—

"Another point is, as you have already remarked, deterioration of the staple crop. I should like to know the reason why this last two years, the only Punjab-American we could use for 22½s was grown between Khanewal and Montgomery. Anything grown north of this line (I am speaking now commercially) was certainly not suitable for 22s. Whether it is that a portion of the crop gets too little for too much water, I am not sure, but think that is a question which the Punjab Department of Agriculture can determine. I can only tell you from actual use, that this last three years only portions of the Punjab-American Cotton have been fit for 22s and it has therefore been a question of selecting every lot offered for sale. The station name does not carry a guarantee even from cotton grown on the line of the Lower Bari Doab Canal."

Mr. W. Vernon, Elgin Mills, Cawnpore, writes :—

"*Re* your enquiries of the progressive deterioration of Punjab-American I find that in the season 1920-21 we bought 2,233 bales. The majority of these came from the Montgomery side. The Lyallpur side has shown a steady drop as regards quality, so much so, that I have refused to look at any cotton tendered from that district."

Mr. Mehta, Express Mills, Nagpur, says in 2 letters :—

"Then I should mention that our object in ordering purchases at Lyallpur was to secure cotton as nearly approximating Umri as possible. As mentioned in my statement of purchases we bought freely in this market in 1917-18, but when we found that the cotton purchased was inferior as compared with our standard Bani cotton, next year we ordered purchase of only pure American. But even cotton supposed to be pure showed thirteen per cent. worse results than our Umri, and our purchases had accordingly to be confined to the most selected cotton in that market." And again,

"In 1918-19 we issued instructions to our Punjab Agents to purchase only pure cotton, as we found last season that the results of mixed cotton compared very unfavourably with those of pure cotton. Our purchases this season also were heavy, almost equal to that in the last season, but as a result of our trials we found that pure American was deteriorating. Accordingly we decided to curtail our purchases in this market and wrote to our Agents to exercise the utmost care in selecting cotton for us.

"Both in 1920 and 1921 pure American cotton showed a greater mixture of short stapled fibres and only a few boras of *selected* pure American cotton were purchased for us.

"In the season 1921-22 owing to scanty rain the crop was very poor, and the results of our trials were disappointing. I may add that this year's kapas samples had some undeveloped and immature bolls in them and the mixture of short fibres was greater than before."

The Secretary, Delhi Cloth and General Mills, writes :—

"We however find that for the last three or four years the quality is steadily deteriorating both in length and strength of the staple. We may mention here that many other friends also hold the same opinion as regards the deterioration of quality."

Messrs. Chrystal and Co. write :—

"There is no doubt that from the practical point of view the cotton has deteriorated to a very large extent and is not in accordance with the results obtained from the figures with which we supplied you. This was particularly the case with the last season's crop. Many of the Bombay Mills including our own have only bought this cotton in extremely small quantities during the last two seasons."

Mr. B. C. Burt himself seems to question the existence of any steady deterioration in quality, but mill-owners and cotton brokers appear to have little doubt that Punjab-American cotton has fallen off in spinning value in recent years, except possibly in respect of cotton from the Lower Bari Doab Colony.

Mr. Milne's report.

9. Thus having exhibited the chief economic facts relating to the recent history of 4-F cotton, the reader is now referred to Mr. Milne's report, printed in Part II of this Report, for a detailed consideration of the

Agricultural and botanical aspects of the problem. Mr. Milne's main argument is that want of water in the critical months of September and October, explains the diminution in yield (and presumably in quality) of 4-F cotton.

On the important question as to whether some systematic deterioration does not accompany the adverse climatic conditions of 1919-21, the reasons advanced do not seem to me entirely conclusive.

Possibility of deterioration of 4-F American cotton.

Mr. Milne, in considering the possibility of deterioration says "Undoubtedly on 4-F fields many plants are now to be met which are not true to type and are very shy bearers, but in both years :—

(*a*) we have found many cases where several fields of 4-F., sown from the same consignment of seed were growing alongside each other, and, whereas the crop in some of the fields or portions of the fields was severely affected, in the others it was not affected.

(*b*) Desi cottons were also ruinously affected in some places."

As to (*a*), if we assume 8 maunds per acre as an average yield of cotton, and if we regard a field bearing only three maunds per acre as severely affected, taking the correlation of yield of adjacent plots as 0·72, and the standard deviation of all fields to be 3 maunds, it is easy to show that an average field will have adjacent to it a field of 3 maunds or less in over 6 cases out of 1,000. That is to say that even on fields whose cultivation is as homogeneous as that of the Lyallpur Farm, a 'severely affected' and an average or unaffected field are likely to found side by side as a pure matter of chance in 6 cases out of 1,000.

Of course if the instances of conjunctions of good and bad yields are much more numerous than 0·6 per cent., Mr. Milne's argument retains its validity. As to (*b*) I may refer again to diagrams II, III and IV which show that the yield of 4-F has fallen off, more than that of Desi cottons since 1918 at the Farms at Lyallpur, Hansi and Sargodha.

There is, therefore, in addition to the diminution of yield common to all Punjab cottons in the last 3 years at Lyallpur

and Sargodha,* a residual diminution shown by 4-F which may, it is true, a rise from climatic conditions specially adverse to American cotton during the last three seasons, but which may be evidence of systematic deterioration. It is vain to attempt to discriminate here between these possibilities, more especially because the yields obtained from the current (1922-23) year's crop may decide the point. The climatic factors influencing the present crop have been as favourable (I write at the end of September) as they are ever likely to be, and 4-F will have a splendid chance of redeeming the reputation which it has forfeited during the immediately preceding years. If it does not do so it is unlikely ever to regain the vogue which it had during the years 1917 to 1921.

There are clearly plenty of the problems for the expert promised to the Punjab by the Indian Central Cotton Committee.

Varieties of cottons and wheat.

10. The battle of the varieties continues, 4-F and 285-F† being the protagonists among American cottons, and Punjab 8-A, Pusa 12, and Punjab 11 among wheats. My views as to the right method of terminating the conflict have been already expressed.

The export of wheat.

11. The removal of the embargo on the export of wheat from India was announced on the 29th September 1922.

---

*At Hansi Farm Desi cottons have shown an upward tendency, which is due very possibly to the successful selection of a high yielding type of Neglectum cotton by Sardar Darshan Singh.

† Table III (*b*) may be consulted for the analysis of relative yields of 4-F and 285-F. Except at Hansi 4-F had the better of it in 1921, but the Sargodha and Khanewal results were not statistically conclusive.

SECTION IV.—Work of Officers.

12. I regret that in this Report, written under sentence of transfer, I am unable to do more than make the briefest possible remarks on the work of the various sections.

Mr. Milne in the dual role of Principal of the College and Economic Botanist has had an arduous task, and he has in addition, taken up the special problem of the failure of American cotton in 1921-22 with enthusiasm, and has written thereon a very detailed report, which, will stand alongside his report on the similar failure in 1919-20.

Mr. Miller Brownlie has made some ingenious inventions, notably a power boring machine, which is to be tested independently by the Sanitary Engineer. He writes also of having discovered a new type of module, which I have not had the privilege of seeing.

Of Dr. Lander's and Mr. Stewart's work I regret I have not seen enough to form an opinion.

Mr. Afzal Hussain, as Entomologist, has worked with continued zeal, and in spite of the absence of Mr. Madan Mohan Lal has carried out research in the laboratory and practical work in the field. Mr. Hem Singh Pruthi is a valuable addition to the section.

Sardar Darshan Singh and Malik Sultan Ali have combined the functions of research workers and propagandists, in their respective circles with centres at Hansi and Gurdaspur. The combination of duties is not conducive to the best results, but this is a defect of the system for which the officers are in no way responsible. I note, with pleasure, that Sardar Darshan Singh's series of cotton tests at Hansi, are systematically arranged, and are such as to permit of assured statistical conclusions being drawn in certain cases.

Khan Sahib Maulvi Fateh-ud-din worked as Deputy Director at Hansi during Sardar Darshan Singh's absence on leave. He received the title of Khan Sahib, a gold watch, and a Sanad, for work done in connection with the visit of His Royal Highness the Prince of Wales.

Of the two other officers recently promoted to the I. A. S. Sardar Sahib Kharak Singh and Chaudhri Muhammad Abdullah I

am able to speak very favourably from my experience of their work as Provincial officers. It is yet too early to speak of their work as Imperial Officers, which it is necessary to regard rather more critically.

I do not propose to single out any of the Extra Assistant Directors or Agricultural Assistants.

S. M. JACOB,

Director of Agriculture, Punjab.

The 30th September 1922.

ANNEXURE I.

Agricultural Schemes in the Air for want of Funds.

I.—Needs of Research.

Particulars of scheme.	Probable Cost.	
	Capital.	Recurring.
	Rs.	Rs.
1. Dry and well farming Research Institute at Jullundur, Ludhiana and Ambala.	5,00,000	1,50,000
2. Irrigation Experimental Station, Lyallpur.	3,37,000	1,66,500
3. Muzaffarabad Experimental Farm ..	2,50,000	15,000
4. Wheat grading Bureau to set up wheat standard for each harvest.	10,000	2,000
5. Crop Experiment Machinery ...	30,000	5,000
6. Punjab Soil Survey	5,000	33,000
Carried over ...	11,82,000	3,71,500

II.—Routine Additions.

Particulars of scheme.	Probable Cost.	
	Capital.	Recurring.
	Rs.	Rs.
1 Assistant Professors' quarters at Lyallpur College.	30,474	...
2. Bungalows for Indian Agricultural Service officers at Lyallpur.	73,696	...
3. Out-door dispensary with Sub-Assistant Surgeon and menials' quarters at Punjab Agricultural College, Lyallpur.	12,444	...
4. Quarters for Assistants at Punjab Agricultural College, Lyallpur.	3,00,000	...
5. Bungalow for Deputy Director of Agriculture, Gurdaspur.	23,000	...
6. Quarters for Beldars at Gurdaspur Farm ...	12,000	...
Carried over ...	4,51,614	...

ANNEXURE I—*continued.*

Particulars of scheme.	Probable Cost.	
	Capital.	Recurring.
	Rs.	Rs.
Brought forward ...	11,32,000	3,71,500
7. Hassanabdal (Northern Circle) Farm	1,00,000	18,000
8. Technological Research on Cotton ...	...	12,000
9. Insectary for Entomologist ...	60,500	...
10. Establishment and equipment for additional Research Officers for Lyallpur 2nd (Economic Botanist, Agricultural Chemist, Agricultural Engineer) and others.	...	3,000
11. Extension of potato work in the province.	10,000	...
12. Extension of Drug cultivation work in the province.		
13. Appointment of a Mycologist for work on Red Rot of Sugarcane; Wilt on gram, Smut and Bunt.	12,000	12,000
14. Animal Nutrition Laboratory ...	1,00,000	20,000

Particulars of Scheme.	Probable Cost.	
	Capital.	Recurring.
	Rs.	Rs.
Brought forward ...	4,51,614	...
7. Buildings for Kala Shah Kaku Farm ...	18,000	...
8. Quarters for one Agricultural Assistant and one Mukaddam at Gurdaspur Farm.	8,000	...
9. Quarters for senior Agricultural Assistant and one Mukaddam at Sargodha.	5,694	...
10. Construction of buildings at Chillianwala Farm.	10,274	...
11. Construction of buildings at Beas Farm ...	15,727	...
12. Verandah in front of Farm Office room at Hansi.	2,730	...
13. Rest-house for officers at Hansi Farm ...	9,888	...
14. Serai for visitors at Hansi Farm ...	51,622	...

15.	Experimental Chambers for water lift testing.	15,000	...	15.	Construction of buildings at Montgomery Farm.	74,310	...
16.	Aeroplanes for photography at £ 2,000 each.	1,80,000	50,000	16.	Appointment of a Gazetted Assistant to Entomologist.	6,000	...
17.	Agricultural Assistants for Research work.	38,400	38,400	17.	Appointment of 4 Agricultural Assistants for district work in Entomology.	9,600	...
				18.	Appointment of 4 Agricultural Assistants for Research work in Entomology.	9,600	...
				19.	Poison Dusting equipment	10,000	...
				20.	Addition of a room for Farm Assistant Office at Gurdaspur.	1,000	..
				21.	Taking over of the District Board Farms at Jullundur, Sialkot, Gujrat and Beas.	12,000	12,000
				22.	Taking over and establishment of 50-60 square Seed Farm at Sargodha.	20,000	...
				23.	Extension of yard at Students' Farm, Lyallpur	4,200	...
				24.	Making of a special new tank at Students' Farm with typical water lift for teaching purposes.	3,700	100
				25.	Extension of Dairy Yard at Lyallpur College	9,950	..
				26.	Four Mukaddams' quarters at Lyallpur Agricultural Station and addition and alteration to Lyallpur Agricultural Station buildings.	36,000	...
				27.	Garden village for all Assistants, Clerks, etc., in College area.	4,50,000	4,500
	Carried over ...	16,47,900	5,24,900		Carried over ...	12,19,909	16,600

ANNEXURE I—*continued.*

Particulars of scheme.	Probable Cost.	
	Capital.	Recurring.
	Rs.	Rs.
Brought forward ...	16,47,900	5,24,900

Particulars of scheme.	Probable Cost.	
	Capital.	Recurring.
	Rs.	Rs.
Brought forward ...	12,19,909	16,600
28. Telephone connection with Hansi Agricultural Station from Hissar or Hansi Railway Station.	3,000	...
29. Electric plant for lighting and fans at Hansi	4,500	...
30. Additional stores for kapas of Farm and for seed purposes at Hansi.	30,000	...
31. Quarters for two Assistants at Hansi ...	11,330	...
32. Additional out-houses for Deputy Director of Agriculture's house at Hansi Farm.	2,500	...
33. 16 Agricultural Assistants for District work...	22,656	22,656
34. Separate Sericultural Section	28,000	28,000
35. Silk Reeling Factory	18,000	45,010
36. Pasteurising plant for Punjab Agricultural College, Lyallpur.	20,000	2,000
37. Well Boring Scheme	2,00,000	1,90,331

			38. Lift irrigation for Economic Botanist and College workshop.	10,000	...
			39. Electric plant for College tube-well, workshop and Farm at Lyallpur.	1,60,000	25,000
			40. Air compressor for tube-wells, etc. ...	10,000	1,000
			41. Purchase of metal cutter for workshop, Lyallpur.	9,395	...
			42. Purchase of South Morton "Lathe" for workshop, Lyallpur.	5,550	...
			43. Rice Farm at Kala Shah Kaku ...	...	4,000
			44. Extension of laboratories (other than Chemical) at Punjab Agricultural College, Lyallpur.	4,00,000	75,000
			45. Ginning Factory at Hansi Farm ...	7,176	...
			46. Purchase of two tractors for Gurdaspur and Sargodha Farms.	16,000	1,600
			47. Installation of another tube-well at Gurdaspur Agricultural Station.	20,000	...
			48. Acquisition of land for Gurdaspur Farm ...	10,000	...
			49. Establishment of a Government Seed Farm at Jhang.	60,900	14,000
			50. Establishment of a Government Seed Farm at Sheikhupura.	1,75,000	15,000
Carried over ...	16,47,900	5,24,900	Carried over ...	23,84,416	4,40,197

ANNEXURE I—*concluded.*

Particulars of scheme.	Probable Cost.		Particulars of scheme.	Probable Cost.	
	Capital.	Recurring.		Capital.	Recurring.
	Rs.	Rs.		Rs.	Rs.
Brought forward ...	16,47,900	5,24,900	Brought forward ...	23,84,416	4,40,197
			51. Swimming tank	21,300	...
			52. Inlet pipe for Swimming tank	20,000	...
			53. Cupola for workshop Foundary	5,000	...
			54. Erection of Silo pits	10,000	100
			55. Establishment of new farms at Gurgaon, Karnal and Ambala.	1,50,000	..
			56. Purchase of a tractor for Hansi Circle ...	10,000	...
Total ...	16,47,900	5,24,900	Total ...	26,00,716	4,40,297

ANNEXURE II.

Statement showing number of applications for admission to the Agricultural College, and number admitted during the last 5 years.

Year.	Applications.		Total.	Admissions.		Total.
	Agriculturists.	Non-Agriculturists.		Agriculturists.	Non-agriculturists.	
1917	78	124	202	23	16	39
1918	100	125	225	37	17	54
1919	178	92	265	47	9	56
1920	202	66	268	50	4	54
1921	151	77	228	45	9	54
1922	210	90	300	43	10	53

ANNEXURE III.

Statement showing the results of the College passing out examination from the year 1914 onwards.

Year.	Class.	Number examined.		Number passed.		Agriculturists.		Non-agriculturists.		Total.	
1914 ...	3 years' course ...	10		9		4		5		9	
1915 ...	Ditto ...	14		14		6		8		14	
1916 ...	Leaving Certificate (2 years' course).	19		19		7		12		19	
1917 ...	Ditto	20		20		12		8		20	
1918 ...	Leaving Certificate	34		34		26		8		34	
	(4 years' course) ..	6		6		2		4		6	
			40		40		28		12		40
1919 ...	Leaving Certificate...	14		14		11		3		14	
	(4 years' course) ..	4		4		3		1		4	
			18		18		14		4		18
1920 ...	Leaving Certificate	18		15		13		2		15	
	(4 years' course) ...	20		17		10		7		17	
			38		32		23		9		32
1921 ..	F Sc. (Agriculture)	26		17		13		4		17	
	B. Sc. (Agriculture)	11		6		4		2		6	
	Leaving certificate...	23		17		16		1		17	
			60		40		33		7		40
1922 ...	F. Sc. (Agriculture)	36		33		29		4		33	
	B. Sc. (Agriculture)	46		31		24		7		31	
	Leaving Certificate	17		10		9		1		10	
			99		74		62		12		74

ANNEXURE IV.

Statement showing disposal of silkworm seed imported during the last 5 years.

Year.	Total silkworm seed imported and distributed.	Number of rearers.	Yield of dry cocoons per ounce of seed.	Average price realized per ounce of seed.	Price per maund of dry cocoons.	Number of districts in which sericulture was practised.
				Rs. A. P.	Rs. Rs.	
1918 ...	506	165	6 to 20	20 9 4	120 to 190	8
1919 ...	472	206	1/5 to 5	3 5 4	190 to 200	9
1920 ...	600	301	6 to 17	32 5 7	227	12
1921 ...	1,762	359	2	9 3 0	211 3 0	15
1922 ...	2,825	886	5 to 19	48 6 0	170 to 250	17

ANNEXURE V.

Profit and Loss Account of wheat seed depôts in the Punjab for the year ending 31st March 1922.

Name of depôt.	Quantity purchased.	Purchase money, including incidental charges.	Sale money.	Profit or Loss.	Remarks.
	Mds. S. Ch.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Hansi depôt ...	3,058 16 1½	27,509 5 3	33,701 3 10	6,191 14 7	Profit.
Lyallpur depôt ...	3,964 12 1	32,789 8 6	44,868 9 9	12,079 1 3	Do.
Montgomery depôt	5,800 0 0	47,063 4 8	59,437 11 3	12,374 6 7	Do.
Gurdaspur depôt	4,915 32 12½	42,266 4 5	52,987 1 11	10,720 13 6	Do.
Totals ...	17,738 20 15	1,49,628 6 10	1,90,994 10 9	41,366 3 11	Do.

Note.—Value of stock (seed and bags) including outstanding balance of 1920-21 in hand on 1st April 1921 has been added to purchase money. Similarly value of stock in hand on 31st March 1922 has been added to sale money.

ANNEXURE VI.

Profit and Loss Account of Cotton Seed Depôts in the Punjab for the year ending 31st March 1922.

Name of Depôt.	Quantity purchased.	Purchase money, including incidental charges.	Sale money.	Profit or Loss.	Remarks.
	Mds. S. Ch.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Hansi Depôt	Seed 4,066 16 15 Lint 595 12 6	37,695 3 3	33,225 8 10	4,469 10 5	Loss.
Lyallpur Depôt	10,516 2 0	65,335 5 9	64,856 14 0	478 7 9	Loss.
Montgomery Depôt ...	13,521 27 14	75,682 1 3	71,343 12 2	4,338 5 1	Loss.
Gurdaspur Depôt ...	9,955 20 0	52,376 14 10	53,017 2 11	640 4 1	Profit.
Totals ...	38,654 39 3	2,31,089 9 1	2,22,443 5 11	8,646 3 2	Loss.

Note.—Value of stock (seed and bag) including out standing balance of 1920-21 in hand on 1st April 1921 has been added to purchase money. Similarly value of stock in hand on 31st March 1922 has been added to sale money.

ANNEXURE VII.

Statement showing sowings of wheat (Punjab-II) in Canal Colonies in the Punjab.

Name of Colony.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.
	Acres.	Acres.	Acres.	Acres.	Acres.
Lower Chenab Colony ...	100,000	150,000	220,000	250,000	350,000
Lower Jhelum Colony ...	45,000	50,000	55,000	70,000	70,000
Lower Bari Doab Colony ...	50,000	100,000	100,000	311,000	324,966
Upper Chenab Colony ...	1,500	2,500	2,500	3,000	5,000
Total ...	196,500	302,500	377,500	634,000	749,966

Statement showing sowings of wheat 8-A. in canal colonies of the Punjab.

Name of colony.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.
	Acres.	Acres.	Acres.	Acres.	Acres.
Lower Chenab Colony ...	...	18	75	248	267
Lower Jhelum Colony ...	...	...	500	3,875	21,000
Lower Bari Doab Colony ...	...	...	30	200	1,570
Upper Chenab Colony ...	...	...	...	...	...
Total ...	...	18	605	4,323	22,837

ANNEXURE

—

Figures of sowings of

Year (Crop in—)	Lower Chenab Colony.			Lower Bari Doab Colony.			Upper Jhelum Colony.		
	American (a).	Desi.	Total.	American (a).	Desi.	Total.	American (a).	Desi.	Total.
1915-16 ...	6,000	147,471	153,471	500	18,093	18,593	...	...	...
1916-17 ...	30,000	143,467	173,467	13,000	26,682	39,682	...	2,307	2,307
1917-18 ...	1,20,000	114,454	234,454	80,000	6,356	86,356	...	20,264	20,264
1918-19 ...	1,90,000	125,067	315,067	152,105	...	152,105	1,000	21,888	22,888
1919-20 ...	2,26,693	122,558	349,251	172,648	44,489	217,137	6,000	33,693	39,693
1920-21 ...	2,73,261	68,938	342,199	227,121	51,714	278,835	10,000	34,676	44,676
1921-22 ...	1,78,653	53,219	231,872	177,609	13,425	191,034	42,733	9,580	52,313
1922-23 ...	118,398	92,899	211,297	164,327	34,574	198,901	24,980	13,025	38,005

Note.—(*a*) American Cotton figures from 1915-16 to 1920-2

(*b*) Desi Cotton figures from 1915-16 to 1920-21 have been

(*c*) The total figures are those as published by the

(*d*) These figures include a small

VIII.

Cotton in Canal Colonies.

Lower Jhelum Colony.			Other Districts.			Grand Total.		
American (a).	Desi.	Total.	American (a).	Desi.	Total.	American (a).	Desi.	Total.
1,200	10,171	11,371	...	...	289,758	7,700	(d) 465,493	473,193
7,000	44,641	51,641	...	...	382,266	50,000	(d) 599,363	649,363
11,500	64,801	76,301	...	...	531,751	211,500	(d) 737,626	949,126
16,000	73,942	29,942	...	...	506,046	359,105	(d) 726,948	1,086,048
60,000	52,906	112,906	...	...	808,381	465,341	(d) 1,062,027	1,527,368
100,000	8,258	108,258	95,000	667,171	762,171	705,382	830,757	1,536,139
64,211	12,789	77,000	22,785	331,946	354,731	485,991	420,959	906,950
42,062	20,759	62,821	15,829	374,106	389,935	365,596	535,363	900,959

have been taken from the reports furnished by Agricultural Officers. D2

obtained by subtraction from total figures published by the Irrigation Department.

Irrigation Department.

quantity of American Cotton.

ANNEXURE

Statement of cotton auctions held by the

1	2	3	4			5		
Serial No.	Places.	Date on which auction held.	Quality special Class pure for seed.			Quality A Class pure not for seed.		
			M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.
				Rs. A. P.			Rs. A. P.	
1	Chichawatni ...	8th December 1921.	...	...	...	105 37 12	16 6 0	7
2	Lyallpur ...	12th December 1921.	...	...	...	129 18 8	16 11 0	9
3	Jaranwala ...	16th December 1921.	...	...	...	1,826 9 12	16 15 0	6
4	Montgomery ...	4th January 1922.	...	...	...	115 28 8	16 2 0	5
5	Phularwan ...	4th January 1922.	...	...	...	229 20 0	16 14 0	1
6	Sargodha ...	6th January 1922.	...	...	...	1,103 4 7	16 12 0	1
7	Malakwal ...	8th January 1922.	...	...	...	...	...	...
8	Baha-ud-din ...	10th January 1922.	1,444 0 0	16 9 0	1	1,739 15 0	16 7 0	1
9	Jarawala 2nd auction sale.	13th January 1922.	...	...	...	withdrawn	...	...
10	Lyallpur 2nd auction sale.	18th January 1922.	...	...	...	248 4 8	18 2 0	6

Note.—Six hundred and thirty maunds cotton was brought on sample in the Lyallpur auction

IX.

Agricultural Department during the year 1921-22.

6			7			8		
Quality A Class up to 1 per cent. Desi.			Quality B Class up to 2 per cent. or 3 per cent. Desi.			Quality C Class up to 3 per cent. Desi.		
M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.
	Rs. A. P.			Rs. A. P.			Rs. A. P.	
371 35 0	15 11 0	7	504 27 0	15 5 0	7	207 8 12	14 6 3	7
...	...	...	323 15 4	15 8 0	9	24 9 4	15 8 0	9
...	...	...	1,239 14 4	16 12 0	5	807 8 4	16 0 0	6
withdrawn	...	...	withdrawn	...	...	withdrawn	...	...
634 2 0	16 11 0	1	...	...	...	531 17 0	16 5 0	1
824 6 12	16 8 0	1	...	...	...	583 26 9	16 6 0	1
...	...	...	No sale.					
495 13 8	15 8 0	1	...	...	...	117 15 0	14 14 0	1
...	...	...	withdrawn	...	...	withdrawn	...	...
...	...	...	239 23 0	12 2 0	7	...	...	...

Sale on 12th December 1921 but was withdrawn at Rs. 16-8-0 per maund.

ANNEXURE

Statement of cotton auction held by the

1	2	3	9			10		
			Quality D class pure other American.			Quality E class other American up to 5 per cent. Desi.		
Serial No.	Places.	Date on which auction held.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.
				Rs. A. P.			Rs. A. P.	
1	Chichawatni ...	8th December 1921.	...	...	...	...	...	...
2	Lyallpur ...	12th December 1921.	...	...	...	...	...	...
3	Jaranwala ...	16th December 1921.	717 0 0	16 10 0	6	851 37 7	16 4 0	6
4	Montgomery ..	4th January 1922.	...	...	...	...	...	...
5	Phularwan ...	4th January 1922.	...	..	...	154 0 0	16 4 0	1
6	Sargodha ...	6th January 1922.	...	...	...	...	...	...
7	Malakwal ...	8th January 1922.	...	...	...	...	...	...
8	Baha-ud-Din ...	10th January 1922.	...	..	...	...	...	...
9	Jaranwala 2nd auction sale.	13th January 1922.	Wi	th dra	wn	W i t	h d r a w	n
10	Lyallpur 2nd auction sale.	18th January 1922.	...	...	...	...	...	...
		Total ...	...	...	...	...	...	

Note.—Six hundred and thirty maunds cotton was brought on sample in the Lyallpur auction

IX—*concld.*

Agricultural Department during the year 1921-22.

11			12	13	14
Quality 285-F., cotton.			Grand total of columns 4 to 11 (total sales).	Total quantity brought in auctions.	Remarks.
M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	M. S. Ch.	Name of buyers.
	Rs. A. P.				(1) Sheikh Muhammad Ismail-Maula Bux.
...	...	...	1,189 28 8	1,351 28 8	(2) Messrs. Volkart Brothers, Montgomery.
					(3) Taneja Factory, Khanewal.
					(4) Harbans Factory, Okara.
					(5) Chaudhari Ghulam Muhammad
...	...	...	477 8 0	633 8 0	(6) Japan Trading Co., Montgomery.
					(7) Bhushan Company.
					(8) Dr. Kishan Singh, Man Mohan Singh, Lyallpur.
...	...	...	5,441 29 11	5,926 29 11	(9) Messrs. Forbes Forbes and Campbell, Lyallpur.
					(10) Japan Trading Co., Lyallpur.
...	...	...	115 28 8	3,787 28 8	(11) Messrs. Ramji Nath-Trikka Ram, Lyallpur.
					(12) Jamna Das, Potdhar.
					(13) Messrs. Khushi Ram-Behari Ram, Lyallpur.
...	...	...	1,548 39 0	2,148 39 0	(14) Messrs Kirpa Ram-Brij Lal, Lyallpur.
					(15) Messrs. Nathu Ram-Gopal Sahai, Lyallpur.
...	...	...	2,510 37 12	6,015 37 12	(16) Ganga Sahai Factory, Lyallpur.
					(17) Lala Balik Ram, Jaranwala.
...	...	...	...	369 5 0	(18) Sardar Harbans Singh, Jaranwala.
					(19) Messrs. Dhanpat Mall-Diwan Chand, Jaranwala.
...	...	...	3,796 3 8	3,796 3 8	(20) Keeho Ram Padhar Nan Kana Sahib.
					(21) Proprietor, Khalsa Factory, Okara.
...	...	...	...	8,613 0 0	(22) Sardar Harbel Singh, Jaranwala.
					(23) Tata & Sons, Lyallpur.
					(24) Japan Cotton Trading Company, Phularwan.
59 2 12	13 2 0	7	546 30 4	649 30 4	(25) Japan Cotton Trading Co., Sargodha.
					Bhai Lal Singh-Jawala Dass.
...	...	...	15,627 0 3	33,292 5 3	(26) Japan Cotton Trading Co., Messrs. Tata and Sons, Lyallpur.

sale on 12th December 1921 but was withdrawn at Rs. 16-8-0 per maund.

ANNEXURE X.

Statement showing the sale of imported implements during the last five years.

Name of implement.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.
Raja plough	63	123	228	166	105
Meston plough	557	153	76	548	189
Other ploughs	41	9	4	5	48
Raja reaper	10	...	8	5	2
Hoes	30	13	8	8	3
Harrows	11	12	54	21	22
Fodder cutters	13	80	50	148 32	174 28
Miscellaneous	...	6	4	11	2
Total ...	725	396	432	944	573

ANNEXURE XI.

Statement showing the sale of implements manufactured by the Agricultural Department.

Name of implement.	Lyallpur.			Gurdaspur.			Hansi.		
	1919-20.	1920-21.	1921-22.	1919-20.	1920-21.	1921-22.	1919-20.	1920-21.	1921-22.
Bar harrows	341	438	191	85	70	19	6	5	5
Drills	181	116	*87	5	25	3	1	...	2
Lyallpur hoes	79	39	...	...	...	...	...	...	...

* Includes Lyallpur hoes.

ANNEXURE XII.

Statement showing the purchase of wheat seed in Seed Depôts of the Punjab in 1922 (up to 28th July 1922).

Name of depôt.	Quantity.		Rate.	Cost.	Incidental charges.	Total cost.
			LYALLPUR.			
	Mds.	Srs.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Lyallpur	1,161	10	5 10 0 to 6 0 0	6,873 0 6	...	6,873 0 6
Lyallpur	82	13	6 3 0	509 6 3	...	509 6 3
Lyallpur	46	18	6 1 6	283 0 9	...	283 0 9
Sangla Hill	242	20	5 15 0 to 6 1 0	1,438 2 0	5 4 9	1,443 6 9
Nankana Sahib	500	0	6 1 0	3,031 4 0	...	3,031 4 0
Tandlianwala	314	20	5 9 0 to 5 11 6	1,771 6 9	15 9 6	1,787 0 3
Jaranwala	340	29	5 8 0 to 5 12 6	1,983 0 3	5 3 6	1,988 3 9
Shahkot	145	0	5 9 0 to 5 11 6	822 5 6	22 13 3	845 2 9
Gojra	142	20	5 13 8	830 8 0	...	830 8 0
Total Lyallpur ...	2,975	10	...	17,542 2 0	48 15 0	17,591 1 0
			MONTGOMERY.			
Montgomery	2,000		5 12 0	11 593 12 0	...	11,593 12 0
Montgomery	2,500		5 13 4½	14,586 11 6	...	14,586 11 6
Total Montgomery ...	4,500		...	26,180 7 6	...	26,180 7 6

ANNEXURE XII—CONCLUDED.

Statement showing the purchases of wheat seed in Seed Depôts of the Punjab in 1922—concluded.

Name of depôt	Quantity.		Rate.	Cost.	Incidental charges.	Total cost.
			HANSI.			
	Mds.	Srs.	Rs. A. P. Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Hissar	2,810	12 13/16	5 11 6 to 6 0 0	17,000 0 0	16 15 6	17,016 15 6
Rohtak	2,395	12 13/16	5 11 0 to 6 0 0	14,641 0 0	368 1 6	15,009 1 6
Ambala	67	20	6 2 0	413 7 0	50 3 6	463 10 6
Karnal	2,017	32	6 0 0 to 6 2 0	12,366 3 0	589 9 0	12,954 12 0
Ferozepore	318	33 5/16	6 0 0 to 6 5 0	1,936 2 0	63 14 0	2,000 0 0
Total Hansi ...	7,609	31	...	46,356 12 0	1,087 11 6	47,444 7 6
			GURDASPUR.			
Sargodha	6,610	26	5 8 0 to 5 14 0	38,329 4 9	1,806 9 9	40,135 14 6
Jullundur	1,135	20	5 4 0 to 6 2 0	6,827 15 9	164 5 6	6,992 5 3
Gurdaspur	133	0	6 5 0 to 6 10 0	722 15 0	23 0 0	745 15 0
Gurdaspur	359	30	6 0 0 to 6 10 0	2,303 11 9	147 8 0	2,451 3 9
Gurdaspur	100	0	5 8 0	550 0 0	15 0 0	565 0 0
Total Gurdaspur ...	8,338	36	...	48,733 15 3	2,156 7 3	50,890 6 6
			ABSTRACT.			
Lyallpur	2,975	10	...	17,542 2 0	48 15 0	17,591 1 0
Montgomery	4,500	0	...	26,180 7 6	...	26,180 7 6
Hansi	7,609	31	...	46,356 12 0	1,087 11 6	47,444 7 6
Gurdaspur	8,338	36	...	48,733 15 3	2,156 7 3	50,890 6 6
Total ...	23,423	37	...	1,38,813 4 9	3,293 1 9	1,42,106 6 6

ANNEXURE XIII.

Consolidated statement showing the purchases of cotton seed in Seed Depôts in the Punjab in 1922 (up to 30th June 1922).

Name of Depôt.	Quantity purchased.	Rate per maund.	Cost.	Incidental charges.	Total cost.
	Mds. Srs. Chs.	Rs. A. P. Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Sargodha	3,583 20 0	4 6 0 to 5 2 0	17,319 4 0	478 14 9	17,798 2 9
Hansi Depôt	2,235 36 4	5 4 0	11,738 8 0	921 3 9	12,659 11 9
Lyallpur Depôt	3,065 10 0	4 13 0 to 6 4 0	14,821 9 0	6 5 0	14,827 14 0
Montgomery	3,978 27 14	4 7 0 to 6 0 0½	19,211 7 9	2,930 10 9	22,142 2 6
Total ...	12,863 14 2	...	63,090 12 9	4,337 2 3	67,427 15 0

Appendix I.

Annual Report of the Principal, Punjab Agricultural College, Lyallpur, for the year ending 30th June 1922.

Staff.—I held charge of the Principalship of the College throughout the year.

The following changes took place among the staff :—

(*a*) L. Madan Mohan Lal, Assistant Professor of Entomology, who had been on 1½ years' leave in Europe studying Sericulture, resumed charge of the duties of Assistant Professor of Entomology with effect from 15th February 1922. On 28th June 1922 he proceeded on 4 months' leave on medical certificate and Bhai Hem Singh, Demonstrator, is officiating for him. L. Harnam Das, M.Sc., is officiating *vice* Bhai Hem Singh.

(*b*) Sardar Sahib Bhai Kharak Singh, Assistant Professor of Agriculture, who finished his course of studies in England, has been promoted to the Indian Agricultural Service and posted to the College as Associate Professor of Agriculture with effect from 19th December 1921.

(*c*) Bhai Labh Singh, Agricultural Assistant, has been appointed Assistant Professor of Agriculture.

(*d*) The post of second Assistant Professor of English recently sanctioned by Government has been filled by Mr. Das Gupta with effect from 20th July 1922.

(*e*) Mr. Wilsdon, Agricultural Chemist, on return from leave, reverted to the Indian Educational Service and Dr. Lander continues as Professor of Chemistry.

(*f*) L. Khushi Ram, Demonstrator in Botany, resigned his post from 1st February 1922, owing to inadequacy of pay, and no suitable successor has been found. Endeavours are being made to have the pay of the posts of Demonstrators in the Botanical and Chemical Sections raised to the same level as that of Physics and Entomology.

(*g*) The two lecturers to the class of Vernacular Middle School teachers who receive training in Agriculture in this College to enable them to teach Agriculture in their schools, have been transferred from the establishment of the Education Department to that of the Agricultural Department. The senior lecturer's post is now the post of an 'A' Division Agricultural Assistant, and the junior one that of a 'B' Division Agricultural Assistant.

(*h*) The post of Assistant Inspector of Agriculture for the inspection of Agriculture in schools has been raised from the Subordinate to the Provincial Educational Service with effect from 1st July 1922 and L. Lachhman Das who

held the previous post has been promoted to the new one. The Assistant Inspector of Agriculture works under the supervision of the Principal of the Agricultural College.

2. *Results of examinations of the English Courses* (*a*) *B.Sc.* (*Agriculture*).—Of 27 candidates who appeared for the B.Sc. (Agriculture) examination this year, 14 have been declared successful, 13 have failed but 10 have been placed under the Compartment rule, *i.e.*, have to re-appear in one subject only.

(*b*) *Subsidiary subjects for the B.Sc.* (*Agriculture*).—Nineteen candidates appeared in the final examination in the subsidiary subjects and 17 of these have been declared successful.

(*c*) *First Examination in Agriculture.*—Thirty-six candidates appeared in the First examination in Agriculture held at the end of the second year course. Of these 33 were successful and two came under Compartment.

(*d*) *The two years' Leaving Certificate Course.*—Seventeen candidates appeared in the Leaving Certificate examination. Ten have obtained the certificate and 7 failed but 3 have to appear again in one subject only.

One casual student went through the course.

3. *Applications for admission to the English Course.*—About 300 applications were received for admission to the main courses (degree and leaving certificate) given in the College. This is the highest number of applications received since the College opened in 1909—fifty-three candidates were admitted. The type of applicants was as good as last year, and most of those selected for admission had passed the Matriculation examination in the first or second division.

The admission may be classified as follows :—

Source of application.	*Number of students admitted.*	
	Agriculturist	Non-Agriculturist.
Ambala Division ...	6	...
Jullundur „ ...	7	2
Lahore „ ...	8	3
Multan „ ...	7	4
Rawalpindi „ ...	8	...
Indian States ...	2	1
Other Provinces ...	5	...
	43	10
	Total ...	53

4. *Scholarships.*—(*a*) The Post-Graduate Research scholarship of Rs. 900 a year has been awarded to Bal Singh who stood first in his B.Sc. examination. He will make a special study of fruit culture and will receive training in the subject in institutions in India where special work is being done on fruits.

(*b*) The following scholarships awarded by District Boards, Indian States, other Provinces, etc., are held by the students of this College :—

District Board	*Number of scholarships*	*Value of scholarship* Per mensem. Rs.
Dera Ghazi Khan ...	1	15
Jhang ...	3	12 each
Hissar ...	1	6
	1	10
Shahpur ...	1	20
	1	25
Multan ...	1	15
Rohtak ...	2	15 each
	1	7
Hoshiarpur ...	3	12 each
Lyallpur ...	2	15 each
	1	10
Amritsar ...	2	10 each
Gujrat ...	1	20
	3	15 each
Gurdaspur ...	1	10
Jullundur ...	1	15
Patiala ...	1	40
Kapurthala ...	1	15 *plus* Boarding House fee Rs. 32.
Faridkot ...	1	30
Delhi ...	2	15 each

To these District Boards and other donors are due our warmest thanks for their generous help to the students.

5. *Vernacular Class.*—Twenty-four candidates took the six months' vernacular course at Lyallpur. Seven of these were employees of the Co-operative Department and the rest were sons of Punjab farmers. All the 24 passed the final examination.

6. *Teachers' Class.*— Seventeen Senior Vernacular certificated teachers took the course to qualify themselves to teach Agriculture in rural vernacular middle schools. All were successful in the final examination. These men were smart and evidently very carefully selected. The spread of the knowledge of Agriculture in vernacular schools is of a very great importance and the educational authorities are taking active measures to make it a success.

7. *Rural Economy Class.*—The Rural Economy Class which lasts for one month was held in March 1922. It was attended by—

4 Assistant Commissioners.
5 Extra Assistant Commissioners.
8 Zilladars and other canal officers.
5 Co-operative Department Inspectors.

Total 22

Officers trained in this class have been a great help to the Agricultural Department when carrying out work in their jurisdictions.

8. *Popular Lectures.*—Mr. Calvert, I.C.S., delivered popular lectures on—

(*a*) General Agricultural Economics.
(*b*) Wheat prices in the Punjab.

Mr. M. Darling, I.C.S., lectured on "Agricultural Co-operative Societies in Italy" and

Mr. W. Smith, Imperial Dairy Expert, lectured on—

(*a*) "The importance of Cattle-Breeding with regard to milk supplies in India."

(*b*) "Urban milk supplies."

These lectures were delivered in the evenings and were open to the public. They were very well attended and much appreciated. We are much indebted to the lecturers.

9. *Attendance of classes.*—I am glad to be able to report that the measures taken to promote punctuality of students in joining the College at the beginnings of terms, and in attending the classes, have resulted in a great improvement in these respects.

10. *Medical attendance.*—A Sub-Assistant Surgeon has been provided for the Institution and resides on the estate. He looks after the health of the students and the subordinate staff of the various sections. This has removed one of our long felt wants and has relieved our anxiety regarding outbreak of epidemics. At present temporary arrangements have been made for his residence and for a dispensary. The permanent buildings required by him have been sanctioned and will, I hope, be erected soon.

11. *Printing press.*—A small printing press has been started at the College. It is of great use in the printing of labels for specimens, simple forms for records, etc., etc. We hope to be able to print Departmental leaflets, etc., with it presently.

12. *Prospectus.*—A Synopsis of the College Prospectus on a single sheet of foolscap paper has been printed in the College press, It contains all information essential for enabling people to decide whether they should enter the College. By issuing this leaflet we hope to save a large number of the copies of the prospectus which are at present called for.

The College prospectus has been revised and added to.

13. *Improved course in Agricultural Economics.*—Having got another assistant professor of English added to the staff, we will now be able to give students a greatly improved course in Agricultural Economics. Such a course has been drawn up, and is before the Syndicate of the Punjab University. We hope to start it practically at once. A good course in Agricultural Economics to the students here, is, in my opinion, very important. It would enable them to understand and push forward what is in the interests of the community ; also would do much to remove present misunderstandings regarding legislation and avoid the consequent agitation. I therefore regard the introduction of this improvement in the course as very important.

14. *An M.Sc Course.*—Regulations for starting an M.Sc. (Agriculture) course have been passed by the University. This is a research degree but we feel that in the absence of an Honours Course to initiate B.Sc. student into the methods of research, an associate professor who will have at least half of his day available to devote to such students must be provided for each section of the College in which the M.Sc. course is started otherwise much success cannot be expected. It is hoped therefore that associate professors will be appointed early in the sections which require them.

15. *Need of Associate Professors in the Botanical Section.*—Now that I have the duties of the Principal of the Agricultural College in addition to those of Economic Botanist for the Province and Professor of Botany, there is urgent need of the appointment of one associate professor of Botany to look after the teaching work of the section and do the important parts of it. Also a second associate professor of Botany is necessary for the starting of the M.Sc. (Agriculture) course if the students are to get the attention and guidance which they get in other colleges in the Punjab. This second associate professor of Botany is also badly wanted to take up research problems on crops which experience has shown should be taken in hand. To my mind the greatest need of the Department is research. It must always be a risky thing to try to teach farming to astute men who have generations of practical experience of farming behind them, unless the advice or other help offered is on particular points which have been made a special study of. It is already evident however that given the proper facilities the Department can provide farmers with improved seeds ; information on such points as the causes of success or failure of their cottons and other crops ; on crop diseases, conservation of soil moisture, methods of keeping up fertility in soils, etc. ; that it can provide them with improved implements, improved wells for water supply, etc., etc. As the province has a population of 24 millions and the majority of the people are directly engaged in farming any improvement in Agriculture is very important.

16. *The Tutorial System.*—Although the supervision of students at their games, etc., has been greatly improved during the past year, the introduction of the Tutorial System which the University Inspection Committee has been pressing for during the past two years is not yet possible owing to want of quarters on the estate for the staff. Great

inconvenience is being felt for want of these quarters and it is hoped that at least the houses already sanctioned will soon be built.

17. *Water supply for the College.*—The water supply for the students baths and even for drinking and cooking purposes and for the work of the laboratories is very inadequate. To ease this difficulty a tube well has been put down in the yard of the College Workshop but we want electric power to work it.

The installation of an electric plant for the city of Lyallpur having failed, we anxiously look forward to an installation of our own.

18. *Hostel Extensions.*—Owing to keen demand for entrance to the College we have utilised the College Rest-house as a Hostel this year. This accommodates about 20 additional students. Material is being collected for the new Hostel.

19. *Laboratory Accommodation.*—Our laboratories are overcrowded and we hope the proposed extensions to these will be accelerated. Materials are being collected for extensions to the Chemistry Block and it is expected that the extensions for this section will be completed within the year.

20. *Acknowledgments to staff.*—In conclusion I wish to thank the staff for their loyal support throughout the year. With their help we have been able to make good progress and to avoid the occurrence of political disturbances in the College, an achievement not attained without infinite pains in these days.

D. MILNE,

Principal, Punjab Agricultural College, Lyallpur.

Appendix II.

Annual Report of the Economic Botanist to Government, Punjab, for the year ending 30th June 1922.

Introductory.—I worked as Economic Botanist throughout the year. There were no changes in the staff.

Wheats.—The season on the whole was rather dry for the wheat crop in winter. Temperatures were not unusual. Dry winds blew occasionally in March and April, but these were not so hot as to have any remarkable effect on the quality of the wheat grains.

At Lyallpur rust appeared very early—in the second week of January—and multiplied rapidly. Cloudy days and light rains in January and February were favourable conditions for its growth. In some of our plots rust was severe and shrivelled the grains considerably. In a few plots the outturns were reduced in this way to about half a crop. In many plots however the grains appeared very little harmed and the yields were about average.

About 700 sowings of wheat were under observation These included the 25 original classified Punjab wheats, over 70 later found types, some Australian wheats, and several hundred crosses. The area occupied was about 31 acres, of which 13 acres were non-experimental. A good part of the land was of fair to good quality, and the remainder was poor sandy loam. The tests were arranged in the usual manner.

Punjab types 8-A, 8-B, 9-C, 16-A, 17-B, cross 2, cross 3 and Pusa 12 were tested against Pb. 11 in square No. 31 on plots of $\frac{1}{8}$th acre each, in two duplicate sets of experiments. One set was sown on 8th November, and the other set on 15th to 16th November 1921. The net result of these experiments is that in outturn of grain 8-A tops the list with one maund 19 seers per acre more than Pb. 11, while Pb. 11 beats all others and stands second in the list. As regards straw 8-A gives about 7 maunds more per acre than Pb. 11. In the late sown set on rich land cross 3 stands second to 8-A as regards grain. In past years cross 3 has done very well on rich soil. It has strong straw and does not lodge easily.

Many crosses have given excellent results, but it is yet too early to say much about them. Australians as usual have given very poor outturns.

Last year I gave details of results got by growing 8-A, Pb. 11 and Pusa 12 for the last 5 years in test plots on the Botanical Experimental Farm, Lyallpur, for 4 years on the Agricultural Farm, Lyallpur, for 3 years on the Seed Farm, Sargodha, and for 4 years at the Hansi and Gurdaspur Agricultural Stations. The obvious conclusion to come to in the case of each station was that in outturns of grain per acre 8-A stood first, Pb. 11 stood second, and Pusa 12 last. The results got this year at the same stations and also at the Government Farms at Montgomery and Raewind confirm this conclusion (*vide* reports of officers concerned). Sargodha Seed Farm is the only exception. In that case I was informed in January 1922 that the germinations of the crop in the test plots were irregular and that the results could not be relied upon.

I understand that 8-A is preferred to other wheats by Punjab farmers and that it is rapidly spreading to a large area. Besides yielding more grain than Pb. 11 the grain is better liked by the people, and it yields more straw which is also a consideration from the point of view of fodder supply.

The more experience I gain at crop testing work the more I am impressed with the necessity of having specially trained men to look after such work. Where this is not done the results of one year seem to contradict the results of the next, valuable time is lost, and the Province is the looser.

In response to requests from Simla Hill farmers for improved wheat types, samples of 8-A, 8-B, Pusa 12 and Sunset (a Lyallpur selection of acclimatised Australian wheat) were grown at Mashobra and Kufri. These wheats were inspected at harvest time. All were doing much better than the local ones and 8-A appeared the most promising of the lot. Growers had already come to the same conclusion. Local hill wheats were found to be very badly affected with Bunt (Tilletia sp.) and cases of destruction by this disease up to 30 per cent. of the crop, were seen growing near our varieties. Our wheats were unharmed by this disease. We expect our varieties to become infected with Bunt (Tilletia sp.) from the hill wheats after some years, but if results such as we got this year can be had usually from good seed wheats sent direct from the plains, there seems to be great scope for helping the hill farmers.

The Ganesh Flour Mill which is being built at Lyallpur is to be available for milling tests of 500 maund lots or over of our wheats. This mill is expected to be in running order this winter.

Brief notes on earcockle disease in wheat (Tylenchus scandens) in English, Urdu and Gurmukhi have been published. As has been shown in previous years, this disease does damage worth lacs of rupees to the wheat crop of the Province annually ; also it has been shown that it can be got rid of in a single season at practically no cost to farmers. Last year we found this disease to be very prevalant in the Karnal district but for want of staff we were unable to attend to the experiments there which we planned. Some further work on the disease has been done at Lyallpur (see Part II of my report).

Cottons.—Eighteen acres of experimental cotton were grown Ten acres of these were of a very sandy porous nature ill-suited for growing American cotton. Desis being more drought resistant and having shorter lint always give us much better results on these plots. Of the remaining 8 acres $\frac{1}{2}$rds is poor and sandy, $\frac{1}{4}$th is hard and compact, and about $\frac{1}{4}$th is fair land. These 8 acres were poorly supplied with irrigation water. About 50 desi selections, 90 Americans and 220 crosses (chiefly desis) were grown in the usual way The desi cottons yielded not far below a normal crop, while the yields of Americans were miserable. The reasons for this are dealt with briefly in Part II of this report. We are interested in the comparative results of 4-F *versus* 285-F, but for the reasons given above it is useless to compare the figures got at Lyallpur.

In the Lower Bari Doab Canal Colony American cottons did rather better, especially in some villages between Mian Channu and Khanewal.

From the report of the Extra Assistant Director of Agriculture, Montgomery, on trials of 4-F and 285-F at Convillepur, Chichawatni, Coleyana estate, Pirowala forest cotton farm, Renala estate, the seed farm, Montgomery, the Military Farm, Okara, and the British Cotton Growing Association Estate, Khanewal, the outturns are in favour of of 285-F, except at Coleyana where the outturn of 4-F was better than that of 285-F by 16 seers per acre. The lint of 285-F is of a much better class than that of 4-F and premiums over 4-F. of Re. 1-4-0 to Rs. 2-8-0 per maund of kapas were got for it.

Improved types of desi cottons have been handed over to the Agricultural Farm, Lyallpur, from time to time during the past dozen years. Seeds of types Nos. 87 Roseum and 24 Mollisoni have been issued by the farm to selected farmers during the past 4 or 5 years but, as there was little demand for desi seed no record was kept of where the seed spread. Now there is a considerable demand for improved desis and this year seeds for about 100 acres of No. 24 Mollisoni have been distributed in the Lower Chenab Canal Colony. These varieties have given very much better yields than can be had from unselected desis.

A Botanical survey of the varieties of cottons grown in the Ferozepore District was carried out on the lines of the surveys already made. Some interesting results are being got from experiments on root-rot in cottons.

State of the cotton crop in the canal colonies.—In September-October farmers complained that American cotton plants especially dropped many of their young flowers and bolls ; that in Americans the first pickings were very poor and late, the bolls did not open properly, the lint was trash, the seeds were not properly developed and the leaves turned yellow and red. They stated that in desi cottons the opening of the bolls and the qualities of the lint and seed were much less affected than in the case of Americans and that the desi cotton leaves did not turn so conspicuously yellow and red but that the losses even in the case of some desi fields were ruinous. The trouble therefore closely resembled that of the 1919 crop.

Enquiries were made into the case, and a preliminary report with tentative proposals for prevention of the trouble in future was written for a conference of Agricultural and Irrigation Officers held on 21st December 1921, to consider the case. A further report has just been submitted. A summary of the latter is given in Part II of the annual report. Our investigations have led me to conclusion that the trouble in 1921 as well as that in 1919 was caused by an insufficient supply of water for the needs of plants, especially in September-October and early November.

Improved cotton types, both desi and American, are now available and farmers have made large profits by growing the American selection in past years, but enquiries have shown us that there is so much misunderstanding regarding the cause of recent cotton troubles that unless the growers understand the position better, they will lose a great deal of money.

Gram.—In the gram wilt experiments the disease appeared very late—in March—and only seriously affected the plot which got no irrigation after sowing. Types Nos. 7, 25, 2 and 23 were used in these experiments and they stood in the above order as regards yields.

Four types of grams *viz.*, Nos. 7, 15, 17 and 20 have been tried for the past four years at the Gurdaspur, Sargodha, Lyallpur and Hansi farms.

At Gurdaspur, all the four types have done better than the local types this year and No. 17 has done better in each of these years. At Sargodha type No. 15 has given the highest yield this year. No. 17 also appears to be promising. At Lyallpur, Nos. 7, 17 and 20 have done better than the local grams. At Hansi the outturns are very poor and do not seem to indicate anything very definite.

Barleys.—Two kinds of English barley, 23 Punjab natural types and some crosses were grown. The season was a good one for barleys, and outturns ranged from 20 to 40 maunds of grain per acre. Four of the most promising types, *viz.*, Nos. 1 (Ly.), 2 (Mu.), 4 (Re.), and 5 (Ly. E) have been tried by the Deputy Director of Agriculture, Hansi, since 1918 in various parts of his circle. Type No. 4 (Re) has constantly yielded better than the local types interstripped with it. It has yielded over 7 maunds per acre more than the local barley grown on either side of it Recently we had complaints regarding the local barley in the Gurgaon district; type No. 4 (Re) has been tried with success in that district. Perhaps it may help to meet the difficulties of the farmers there. We are looking into the case.

Oats.—Six varieties of Scotch oats, and two of French oats were tried against the desi varieties. The exotic varieties have given higher yields of; grain than usual. These oats are not grown so much for grain purposes as for fodder; however in this respect the Scotch and French oats have consistantly done better than the desi oats. Scotch oats are in demand as a late-Rabi green fodder and seeds are being distributed as far as possible. From our experience it appears that oat-grains might be imported from Scotland direct to farmers here desirous of growing them for fodder, and that a change of seed on account of deterioration of the type should not be necessary for several years.

Potato experiments in the Simla Hills.—Experiments were carried out on farmers' fields near Mashobra, Kufri and Fagu. Six Scotch varieties were grown interstripped with the desi variety at each of these places. On the average the growers got 53 maunds 2 seers of tubers per acre more from the Scotch, than from the desis this year. The average price of potatoes in the field in that locality at the time our crop was harvested was about Rs. 5 per maund, therefore the growers got Rs. 265-4-0 per acre more from their Scotch than from the desi potatoes. For several years back we have been getting about 50 maunds more from these Scotch potatoes than from the desis. It has not been possible to ascertain the exact area under Scotch potatoes in the Simla hills up to date, but we estimate that there cannot be less than 400 acres under them.

Twenty-one new varieties evolved by us from seeds during the past few years were grown in small plots and the work on these is continuing.

Date Palms.—The 2½ acres of Arabian date-plantation in the Taleri garden, Muzaffargarh, is in good condition. The crop under report was a moderate one. For want of proper fruit curing sheds about two-third of the crop was considerably damaged during rains. In spite of this however we had a gross income of Rs. 400 for fruits. In the previous year (1920) this plantation gave a gross income of Rs. 600 for fruits. The crop in the coming year (1922) now being handled is much heavier than before and therefore we expect a still higher income. The trees are still very young and all of these have not come to full bearing age. The plantation has now reached a stage where with proper facilities, the inter crops, etc., which could be got from it, should pay for its up-keep except the work on the fruits.

Last September over 500 Arabian date suckers were planted in the Arabian date plantation bordering on the Taleri Bagh, Muzaffargarh. The total area covered by date trees in this plantation is now about 5 acres.

The five inch tube well sunk in this plantation by the Agricultural Engineer in 1920 has worked very satisfactorily. There is a keen demand for Arabian date suckers in the Province, and applications for them are constantly received.

Fruit farming.—A number of fruit farms have now come under our supervision. Sardar Bal Singh who has just graduated from the College has been awarded a research scholarship of Rs. 900 per annum to study fruit farming and allied subjects at the institutions in India where work on these subjects has been done.

Red rot in Sugarcane.—The experiments on sugarcane red-rot (Colletotrichum falcatum) conducted at Ferozepore were extended to Dharamkot by request of the Deputy Director of Agriculture concerned.

Maize and rape.—For want of staff work on maize and rape could not be given much attention.

Acknowledgment.—I wish to acknowledge my great indebtedness to the staff for the hearty assistance which they have given me throughout the year. Each one of them has now spread before him far more work than a single man can handle, they have spared no pains to bring out something of real value to the province.

D. MILNE,

Economic Botanist to Government, Punjab, Lyallpur.

APPENDIX III.

Annual Report of Agricultural Chemist to Government Punjab, for the year ending 30th June 1922.

1. Mr. S. M. Nasir proceeded to England on long leave for further study on 10th August 1921.

Lala Girdhari Lal, B.Sc., was appointed to fill this vacancy on 11th August 1921.

2. *Provincial Work.*—An abstract of routine work undertaken for private individuals and other Government departments is given below;—

Soil	74
Sugarcane	80
Feeds and fodders	7
,, (poisonous)	14
Soil water	10
Manures	15
Miscellaneous	13
	213

In addition to these 918 individual samples were analysed in connection with the Chemical investigations going on in the Laboratory.

3. The soil survey mentioned in my last report has not yet been sanctioned by Government.

4. *Research reclamation of Bara Land, Montgomery District.*—The details of the field work which has been carried out during the year are given in part II.

The treatment of the soil with gypsum and castor cake continues to give good results, the crop produced being far superior to that produced on untreated land. At the present time, however the best crop produced on treated land is not such as would be considered an economic crop on ordinary soil, and in weighing the possibilities of a permanent and economic reclamation the following points have to be considered. Alkali is appearing on certain parts of the bara land and there appears to be an intimate relationship between bara and alkaline conditions, and I am at present estimating alkali contents to a depth of 12 feet or more to determine to what depth the salts extend. Should the salt go down to any considerable depth, then the problem of a permanent surface reclamation, without continuous heavy irrigation and drainage would present very considerable obstacles.

At the present moment it is not possible to say what yield of crop will be given in the following year or two on the treated land, and so offer a definite opinion as to the possibility of obtaining an economic yield.

This was the first year in which the sugarcane had been sown and of course the crop though a distinct improvement on that from untreated bara was in no way comparable with a normal crop. Wheat will be sown in the following Rabi on the land from which this cane was gathered last Spring.

5. *Saline lands in the Montgomery District.*—Experiments are being carried out under my supervision by Sardar Inder Singh at Pinjripur and these fall under the following headings:—

1. Scraping the superficial layer of salt from the soil and then cultivating.
2. Heavy irrigation, allowing the water to soak in and succeeding this by further flooding till the time for cultivation.
3. Scraping the land and allowing it to remain fallow without any further cultivation to note whether any further rise of salt occurs.

The results so far obtained are hopeful, scraping appears to improve the subsequent yield far better than merely flooding the land, and no appreciable rise of salt has been noted on the scraped and unirrigated land after a year.

6. *Green Manuring at Gurdaspur.*—The residual effects of last year's first application of green manure has been noted on the wheat crop, which were gathered last April, the returns of which are being given in part 11, next year the residual effects after two seasons will be noted. Trials are also being carried out on the land of Khan Sahib Chaudhri Muhammad Bukhsh at Bhaini Milwan near Gurdaspur, where Bhang is being carted and ploughed in.

At Lyallpur trials were carried out on sandy plots, which however proved to be very uneven and the general effect of the green manure was pronounced. These yield from the green manure plots are being compared with corresponding artificial plots. Details of these trials are given in part II.

7. *Sullage disposal.*—The sugarcane crop grown last year was sold, experimental results could not be continued for reason given in last year's report. A new engine has been acquired from the Sanitary Board and in April this year a new set of trials on maize with rotation as maize, vegetables and sugarcane was started, these will be continued throughout the year and it is hoped to be able to present data on the efficiency of varying dilution of sullage water on crop production.

8. *Bacteriological Investigations.*—During the past year these investigations have been chiefly confined to the Laboratory. The object was to get at the controlling factor in nitrogen fixation. As however these results would not be complete without tracing the progress of the previous Laboratory work (which has not appeared so far in the report) the work of 1919, has been also put down. Details of the work are given in part II. It will be seen from

these results that a fixation of 30 per cent. of nitrogen is common and in one instance it reached 75 per cent. without the addition of any carbohydrate, yet the decisive controlling factor has not been fixed upon, the gain and loss of nitrogen being sporadic.

(*b*) The changes in nitrogen content of a typical loamy soil of Lyallpur were also studied from time to time. There has been generally speaking a loss of nitrogen from the soil, this being particularly pronounced during the rainy season and subsequently the average loss for the season was 4·3 per cent. Details of the work are given in part II.

9. *Animal Nutrition Work.*—During the past year an attempt has been made to determine the digestibility co-efficient of certain food stuffs. An elaborate series of observations and analyses have been made but only two animals were available for the work in hand. The results obtained are at hand but it is not considered advisable to present them till they can be supplemented by further work on the subject.

10. *Narwala Saline Lands.*—During the past year observations on the salt content of kallar patches at Narwala have been made down to a depth of 12 feet at various intervals. The salinity here appears to be confined to the upper six feet and the effect of an irrigation is to move, the salt content only to an extent of 6 inches.

I hope to be able to apply several heavy irrigation at intervals of 10 days, now in order to see if the salt can be washed out more completely from the salt containing layers. Details of the whole set of observations will be held over till completed.

11. *Miscellaneous.*—*Sugarcane.*—About 80 samples have been analysed at Gurdaspur from different varieties, with a view to determine the best yield.

Bara Soil.—An investigation is proceeding with a view to throwing light on the nature of the hard surface layers of bara soil.

P. E. LANDER,

Agricultural Chemist to Government,
Punjab, Lyallpur.

APPENDI IV.

Annual Report of the Entomologist to Government, Punjab, Lyallpur, for the year 1921-22.

I.—General.

Teaching.—Once again I have to point out that the time devoted to the teaching of Zoology, Physiology and Entomology is not sufficient. To impart to the students an education on which they could build up in after years is a higher ideal, the time at our disposal does not even enable us to make them masters of such elementary facts as are absolutely necessary to make them useful farmers. It is very essential that Entomology should be given its rightful place in the college curriculum. The days when it was regarded a ' minor subject ' have long been past. Before trying to produce more we must first learn to preserve what we produce.

Laboratory and Insectary.—The Entomological laboratory has long been overcrowded and a number of students in each practical class have to work under conditions of great disadvantage, both regarding space and light.

We are still without an insectary, and in this respect are an exceptional entomological institution. No less than 50 per cent. of our breeding experiments fail for want of a proper place, and no progress in Applied Entomology is possible without the study of the life-histories of insects. Plans of an insectary have already been submitted.

Propaganda.—Enough stress cannot be laid on this, very essential, side of our activity. Success of Applied Entomology will be possible only when the farmers and fruit growers begin to recognise the importance of insect activity in their work. Education of the zemindar must, therefore, be the first aim of our department, and exciting his curiosity is the preliminary essential stage in this education. Exhibits were sent to the following places:—

Palwal, Choa Saidan Shah, Gurgaon, Lyallpur. And in addition we contributed effectively to the attractions of the Badshahi Mela held at Lahore.

Actual demonstrations, on field scale, were given at Gurgaon and Gurdaspur on killing rats by fumigation.

Field Operations.—The Entomological Section is very often called upon to undertake extensive operations in killing crop and fruit pests. During the year, in addition to giving advice to many, we were able to carry out spraying, fumigation, baiting and dessication at the places given below:—

Localities.	Pest.	Crop.	Operations.	Remarks.
Mehdiabad ...	Citrus Aleurodes	Maltas, etc.	Spraying ...	424 trees sprayed.
Gujranwala ...	Citrus scale Aleurodes.	Do.	Do.	1,025 trees sprayed.
Lahore (Baghanpura.)	Mango-hopper ...	Mangoes	Do.	460 trees sprayed.
Lahore ...	Monophlæbus ...	...	Do.	Was a regular nuisance at the Kinniard College.
Sialkot ..	Field rats ...	Wheat & sugarcane.	Baiting & Fumigation.	214 rat burrows treated.
Jullundur ...				
Gurdaspur ...				
Montgomery ...	Khapra ...	...	Dessication & Fumigation.	
Kharewal ...	Do.			

Most of these operations have been completely successful, but it must be said that we are not doing enough of this work. For a handful of workers, it is not possible to do more. For field operations an establishment bigger than the present entomological section is required. Rats alone cannot be kept in check without an organization much bigger than that set apart for the work of exterminating all the animal pests of the plants in the Punjab.

Research.—Taking everything into consideration we have made very satisfactory progress in bringing to light new facts about insects injurious to crops, and in utilising the knowledge thus gained for the purposes of exterminating our pests. Sericultural operations have, however, materially interfered in entomological research, and we have been greatly handicapped for want of an insectary. Research work is possible only when the worker devotes his whole-hearted attention towards one problem, and one alone, at a time. And one might be permitted to point out that the so-called 'district work' does not make a good combination with research. All my assistants have complained of the diversity of their duties, and I am certain that the whole tone of research would have improved, if it were not for the multifarious activities of the members of this section.

Material for Publication.—Inspite of the difficulties referred to above, we have been able to get the following papers ready for publication:—

1. The Habits and Life History of *Idiocerus*, the Mango-Hopper.

Furthermore it remains to be seen whether the reclamation will be permanent.

2. A Note on the Parasites of *Earias insulana* (the Cotton Bollworm).
3. A List of Parasites of the Insect Pests in the Punjab.
4. The Study of the Genitalia of *Idiocerus spp.*
5. Description of a new Jassid.
6. Instructions in Practical Entomology for the use of Agricultural Students has been written by Mr. Hem Singh Pruthi.
7. Practical Zoology and Physiology for the Students of Agriculture has been written by Lala Harnam Dass.
8. Material for a Hand-book on Applied Entomology for the use of the Students of the Agricultural College has been collected and it is hoped that a book on this subject both in English and Vernacular shall soon be in the hands of those interested in Applied Entomology.

The following leaflets have been prepared in the vernacular:—

9. Psylla Disease of the Citrus Trees and how to control it.
10. How to prepare and use insecticides ?

II.—Entomological.

Cottons.—Insect pests did not contribute towards the causes which brought about the failure of the American cottons during 1921. The bollworm attack was below normal.

The figures of the percentage of parasitization of the bollworms have been collected from the different parts of the Punjab. Those from Hissar and Gurgaon are fairly high, at the former place as many as 50 per cent. of the bollworms were found parasitized by *Bracon lefroy* and *Rhogas testaceous.*

Sphenoptera gossypii appeared in some fields at Lyallpur and Montgomery, the damage during 1921 was very slight. This year again it is making its appearance. It is a very serious pest of cotton in some parts of Madras and Bombay, and is very difficult to control. We are studying this insect very carefully.

Sugarcane, Maize and Jowar.—The problem of the moth-borers has reached a very acute stage, particularly in relation to the fodder question, and immediate action is very essential. The study of the life history and bionomics of these insects was taken up, and some figures of the increase of the borers were collected. In a field of sugarcane at Lyallpur the number of plants damaged by these insects rose from 1·8 per cent. in April to 11 per cent. in June. When it is recognised that a single female may lay 300 or more eggs, and that the whole life-cycle is completed in a month, the above increase does not seem at all surprising.

The best, the surest and the most economical method, is the one which comes under the category of ' Agricultural operations.'

The figures collected from the various parts of the province prove once more the established fact that the moth-borers hibernate in the stubbles as caterpillars. To destroy them, therefore, the stubbles should be collected and burnt. We have, for sometime past, been advocating this measure, but evidently with no effect. The stubbles are either left in the fields or collected and left in a heap outside the field. Both practices are equally dangerous. I am sorry to remark that even on our Demonstration Farms the practice of leaving stubbles in a heap on one side of the farm is common. The reason for this may be that the officers in charge of these farms are convinced of the futility of conducting such operations on a solitary field or so. Against pests that possess means of rapid dispersal only concerted action over an extensive area can bring relief. In my report for the year 1919-20 (part I) I suggested that legislation was the only effective means of ensuring action against this pest. Without some sort of motive force general and concerted action is not possible. We must by Law make it incumbent on every farmer to take action against this pest. This is no innovation. In Egypt it is solely by the aid of the force of Law that they are able to keep in check the pink bollworm of cotton. In most properly organised countries laws and regulations are the main force which compel the farmers to take effective measure against insect pests. Legislation is the backbone of an organised society, and if one can justify legislation which gives to public bodies the right to dismantle buildings which may be dangerous to public safety, then there is stronger justification for regulations to protect our food and the food of our domesticated animals.

Citrus.—Some cases of the attacks of *citrus psylla* were reported and successfully dealt with by spraying. The figures collected from Gujranwala and Lyallpur indicate that the parasite *Tetrastichus radiatus* (Chalcid) is very effective in keeping *Euphalerus citri* in check, and during certain parts of the year is responsible for the destruction of 86·5 per cent. of the nymphs. It is important that spraying operations are not taken in hand in localities where the percentage of parasitization is high, or if necessary should only be resorted to when the parasites are not present. We must not kill our natural allies.

It was found that citrus hedges round the Sadar Citrus garden at Gujranwala harboured a large number of citrus pests. In localities where citrus orchards are grown these hedges should be strongly discouraged.

Another pest of citrus trees that has so far baffled our attempts in dealing with it satisfactorily is *Dialeurooii citre.* We only came across it during the last year, and the study of life-history, etc., etc., is in progress. Spraying was done against this pest at Mehdiabad and Sargodha and although the majority of insects were killed we were not as completely successful as we would have liked to be.

Mango.—The very severe summer of 1921 very probably killed off the mango-hoppers in large numbers. We can safely say that

during this year and the next the *tela* shall be very slight. Light traps have been tried and found a useful addition to our armoury against this pest. The garden at Baghbanpura, which we have been spraying for the last two years, was sprayed during the winter of 1921. This garden is now entirely free of hoppers. On account of the extraordinary metereological conditions we have not been able to convince the fruit growers of Lahore that spraying is a cure for *tela*. We however intend to keep the above garden under experiment till such time that we have clearly established the value of insecticidal method of insect control.

Castor.—The North-Western Railway have been, for the past two or three years growing castor over extensive areas. Judging from the conditions to which insects reduce these plantations everywhere one could safely say that prospects of a profit are limited. And it is not unlikely that even the money spent on outlay has not been recovered. This shows the power of our six-legged enemies. The problem has been taken up and a study of the insects doing this damage is in progress. It is too early to suggest any remedial measures.

Stored grains.—We have been able to confirm Prof. Dendy's results on air-tight storage. About 60 experiments were performed, and in all completely air-tight vessels the larvæ of *khapra* beetle died within a few days. Even very badly infested wheat when kept under air-tight condition improved, in so far that all the stages of insects attacking it were killed. The absence of oxygen makes insect life impossible and it seems that the presence of carbon dioxide hastens this action. Carbon Dioxide is being used in some countries for killing pests of stored grains. We are experimenting with this gas.

All our attempts to devise such methods of air-tight storage as could be employed by the villagers have not so far given any results. The work is being continued.

Superheating was employed in killing the larvæ of *khapra* in the seed godowns at Montgomery and Khanewal. When treating empty seed godowns dessication is cheaper, and as successful as fumigation with CS2 or HCN acid gas.

The elevator at Lyallpur remained almost empty during the last year. It has already been suggested that in order to guard against ' weevilling ' in the elevator a heating machine should be installed, and all the grain brought in should be treated so as to make it impossible for any stage of insects to survive. The object of an elevator should be to store clean wheat (free from insects), keep it clean and send it out clean. Unfortunately the elevator at Lyallpur does not satisfy this condition in so far as the insects are concerned.

III.—Zoological.

Rats.—Reports of damage by rats continued to pour in. An advance over last year was made by the introduction of fumigation. The use of poison baits is not without danger to the domesticated

animals, and fumigation with a proper machine has the advantage of being more certain and less risky. In all 1,365 burrows were successfully treated; it was not possible to do more. To exterminate rats, which are more than human beings in numbers and are found all over the globe, is an impossibility but it is possible to check them so effectively that they do but little harm to growing crops. A co-operative and continuous action is required for this. Every farmer must regard rat killing as much an agricultural operation as weeding. It is really strange that while every cultivator is anxious to remove weeds from his fields almost all are unmindful of the harm done by the animal pests, which they regard as heavenly agents of destruction not to be interfered with. Nothing but the proper understanding of the problem would help. We are arranging to take up a village or two and by organised action clear it completely of rats. This would help to convince the villagers of the potency of our methods; but for an effective control proper organisation and regular compaigns are necessary. Unfortunately we have neither the staff nor funds for such an undertaking.

IV.—Sericulture.

The total amount of silk seed reared in the Province was 2,825 ounces as against 1,762 ounces during 1920-21. The total produce brought to the auctions at Gurdaspur and Hazro was an unprecedented quantity of 130 maunds of dry cocoons; which fetched about Rs. 30,000. In addition to this about 70 maunds of dry cocoons were reeled by the rearers and yielded about 14 maunds of silk yarn worth about Rs. 17,000. Thus silkworm has brought nearly half a lakh of rupees to the pockets of our rearers and this works out at Rs. 57 per head. It must be said that if it were not for adverse conditions the yield would have been four times. The hot winds unfortunately appeared early and the harvesting started before the rearing was over. The supervising staff, moreover, was not enough for the work. The highest yield for an ounce of seed has been 19 seers 2 chataks and was valued at Rs. 109. This shows that one man in about 40 days can earn over Rs. 100.

The total number of rearers was 880 as against 490 during 1920-21. Sericulture was introduced in 124 schools as against 46 last year. I have to thank the Director of Public Instruction, for his help in the work.

Silk exhibitions were held at Gurdaspur and Hazro and prizes to the value of Rs. 550 were distributed amongst good rearers.

Mr. Cowan, Deputy Commissioner, Campbellpore, has given me very great help in the introduction of sericulture in Campbellpore and Sheikh Zahid Hussain, Honorary Sericulture Assistant is to be congratulated on his success in this difficult locality.

As has been pointed out above there is no staff for sericulture and the extra burden of the work falls on the shoulders of the Entomological staff, and we have been working under great pressure and considerable inconvenience.

I particularly wish to mention the hard work done in sericulture and silk exhibitions by:—

Sardar Hem Singh Pruthi ; Lala Dina Nath ; Lala Kesho Dass and Sayad Abdullah Shah.

For the next year I have only ordered 1,500 ounces of seed. This step backward is very unfortunate but without any staff and at the expense of Entomological work I do not feel justified in increasing sericultural work.

Mulberry Plantations.—The work of planting mulberries on the waste banks of the Upper Bari Doab Canal has continued. Over 3,000 seedlings have been transplanted into permanent plantation. The total number of plants now stands at 6,600 and, during the coming rainy season, it shall be further increased. In about three years' time the plantations will be able to supply leaf for worms hatched out of 400 ounces of silk seed. There is a fair proportion of the early varieties and this will enable us to start the work earlier and thus escape the severe season. Arrangements have been made to start plantations near Kunjar on the Upper Bari Doab Canal. I have to thank the Irrigation Department for the help they give us in this work.

Unfortunately the District Boards are reducing the total number of mulberry trees by cutting them without replacing them by new plants. Sericulture cannot progress without extensive mulberry plantations.

I take this opportunity of recording my appreciation of the help given to me by Sardar Hem Singh Pruthi in teaching, research, management of the laboratory and district work. He is leaving us for the purpose of higher studies in England and it shall be difficult to replace him.

M. AFZAL HUSAIN,

Entomologist to Government, Punjab.

APPENDIX V.

Annual Report of the Agricultural Engineer to Government, Punjab, Lyallpur, for the year ending 30th June 1922.

Introductory.—I returned from long leave on 27th July 1921 and have since been in charge of the Engineering Section.

Workshop.—Apart from the small expense involved in providing a gate for the new workshop compound no expense whatever has been charged against the estimate for this work during the year under report. The various machines fixed in position prior to my return from leave have all been removed and refixed in economic positions, the work being done gradually and the costs debited to workshop contingencies. The wood flooring shown in the supplementary estimate prepared during my absence has not yet been laid as it is considered advisable to have all machines in position, trolly lines and pipe lines laid before this work is taken in hand, and in view of the financial stringency it is considered advisable to instal first the absolute necessities before embarking on items for which there is no great urgency. The electrical scheme, proposed in 1919, for Lyallpur has apparently fallen through and therefore work is considerably handicapped for suitable power to run the various machines. As a temporary measure oil engines from stock have been erected and with three of these certain of the machines have been working for most of the year under report. The method is undoubtedly expensive as it necessitates a separate driver for each engine with the subsidiary expenses that such a system involves. The original estimate for the new workshop included a water tank and water channel for testing and experimental work connected with various forms of water lifts, after discussion with the Director it was decided to postpone construction of this tank, etc., and ultimately to instal deep chambers which would cover a greater variety of conditions found in the Province. Unfortunately while I was on leave the money allotted for the tank and channel was spent on alterations and alleged improvements on other features of the workshop, consequently this line of investigation is at present postponed for the reason given and also until electric power is available.

Even with the temporary engine power available it is satisfactory to note that many of the new machines have already shown a considerable saving over the hand labour methods previously in use, while work is much more expeditiously carried out and a general improvement in finish has been obtained. Electric power is however an urgent necessity as we have been unable so far to run several machines and works in progress in the Province are frequently delayed for several months while some small fitting or item of machinery is being manufactured by a private firm.

Power Boring Plant.—Early in 1918 a power boring plant was purchased from Australia at a cost of approximately Rs. 7,000 and

after a few weeks' trial in the Punjab it was sent to Bushire on war work. The trials made in the Punjab with this plant showed that its life would not exceed twelve to fifteen months' work, the repair bill during the life of the machine being unduly high. The chief reasons for the defects noted being that the machine was designed for conditions unobtainable in India. Since that date the energies of the engineering section have been devoted to discovering average soil requirements in the Punjab and to the production of a machine embodying these requirements. Several designs have been prepared and the machines tested, but it was only in the year under report that a suitable machine was evolved.

Two trial bores have been put down with this machine and the results compared with hand boring in the same soil give the following results.

Total depths of bores, 276 feet.

Hand boring 13 to 15 men employed for 193 days the cost being practically Rs. 2,000.

Power boring, 5 men employed for 60 days the cost of labour, oil, fuel, etc., being Rs. 600.

It is interesting to note that the costs given are in favour of the power boring plant as in one test where a 12 inch casing tube was sunk 276 feet and compared with a 15 inch casing tube sunk to the same depth by hand, the cost of the power work amounted to Rs. 286 the time taken being 26 days, while the hand bore took over six months and cost over Rs. 3,000.

It is still too early to say that these great differences in boring costs will be maintained—particularly when the power machine is working out in the district far from the daily supervision of accounts, but it is safe to say that with this machine boring costs will be reduced to less than one-half of the costs for hand work. Working models of this machine were exhibited at Lahore *mela* during the visit of His Royal Highness the Prince of Wales and also at the Sikh Educational Conference Exhibition at Delhi and attracted considerable attention.

Cheap Strainers.—At the conclusion of my annual report for last year I pointed out that Mr. McCormack had been investigating the possibilities of introducing a bamboo form of strainer used in parts of China. Investigation of these strainers led to the conclusion that the material used was much too irregular in structure ever to be successful in the complete exclusion of fine sand and that unless very carefully and constantly supervised during construction the waterway area was likely to become considerably greater than would prove efficient in these very coarse subsoils in which such a material could be used. The necessity however for a cheap and efficient strainer has been keenly felt for several years. During the year under report extensive and elaborate experiments have been carried out with a view to producing a straining tube of stoneware. When one considers that the engineering staff at Lyallpur is engaged on civil, mechanical and electrical work, the difficulty in

persuading members that they were expected to become proficient potters will be apparent. That this persuasion was necessary is due to the rooted objection of the Indian potter to take up a line of work with which his forefathers were unfamiliar. Such being the case certain members of this staff were obliged to spend several weeks in study of the potters' art and then to actually mould, dry, fire and glaze the various shapes and sections that were under investigation. Various mixtures of earths had to be tried to obtain patterns which would not buckle or warp when drying, or when being fired. Coke, oil, gas and electricity were each tried in the firing process and results carefully compared. The experiments carried out were then brought to the notice of several potters who, having seen the results produced by people who admittedly knew nothing whatever of the art, declared that they were prepared to try and produce the requirements of the department. It would have been a simple matter to have had the parts made up at Staffordshire in England, but the Punjab potters on seeing samples from Staffordshire declared that it was impossible to produce these in India—that type of work was not done—and as an enormous consumption of these stoneware parts was anticipated I was particularly anxious to have them produced in India, and in the Punjab, if possible.

Pottery firms at Multan, Gujrat, Lyallpur, Sialkot and Jubbulpore are engaged on this work and although perfection has not yet been achieved the work has reached a stage where success is assured and it is safe to predict a revolution in strainer tubes in the Punjab, thus marking the commencement of a new industry. In this connection I wish particularly to acknowledge the help I have received from M. Muhammad Abdulla, well supervisor and from M. Ali Muhammad, Foreman, the latter's arrangement for removing the moulded parts from the mould of a high power press will go far towards rapidity in manufacture.

Automatic Regulator.—While investigating the suitability of various forms of channels for purposes of accurate water measurement I discovered that the $\sqrt{2gh}$ discharge in a "Venturi" flume remained unimpaired if a particular shape of displacer was introduced in the throat of the flume. Investigation resulted in the design of a displacer which can be operated to give different throat areas without the introduction of a variable constant. All details have been worked out for several sizes of flumes, for example, in a flume throat 4 feet wide and 5 feet high, a fixed discharge of 100 cusecs can be obtained on heads varying from 3 feet to 0·4 foot, or a discharge varying from 278 cusecs to 36 cusecs on the same heads. The displacer is provided with differential float actuators, is self-acting, electrically controlled, and by a further addition, similar to that in electrically controlled clocks, the displacer may be operated from headquarters many miles from the regulator. The significance of this device may be of interest to members of the Irrigation Department.

Persian Wheels.—The Director, Mr. Townsend, has for many years been particularly keen on the production of some form of

bearing which would considerably reduce friction and be inexpensive to produce. Several firms have been encouraged to investigate this line and several forms of ball bearings have been devised for Persian wheel work. These ball bearings have proved expensive, the cost being about Rs. 80 per pair, and have not possessed the necessary capacity for the work to be done, consequently their life was a short one, six to ten months being the average. The cost of a more lasting bearing was out of all proportion to the advantage gained and hence the old wood wheel creaks on. During the year under report an inexpensive form of self-lubricating roller bearing has been devised and this promises to have an excellent life. It is hoped to produce these in numbers at a cost of not more than Rs. 50 per pair. The bearings were primarily designed for use on a metal Persian wheel but can be used on a wood wheel although their use in such a case is not unlike the fitting of a side car to a motor-cycle—mechanically unsound, but popular.

Ploughs.—Observations of the various types of ploughs in use in the country have led me to conclude that the type required by the cultivator in the Punjab for general purposes is not an adaptation of the patterns in use in western countries, but, a scientifically designed adaptation of the "*desi hal*" adaptations of western ploughs on the lines of the "Raja," "Meston" and similar makes appear to suit certain conditions of soil and *cultivators* and until a more suitable pattern is forthcoming the "*desi hal*" of the ancients will continue to be used for four ploughings out of every five. When a suitable pattern arrives, no propaganda will be necessary to introduce it and it will not only be produced for work during the inspection of officials, but will "catch on" through its own merits. Keeping this end in view considerable attention has been devoted to the scientific design of a simple plough for general use and work on this is being continued. It is impossible however to keep all lines of investigation moving as rapidly as one would like, with only a very limited staff: work on one line has frequently to be suspended for months at a time while more pressing work is being attended to. An article to the Agricultural Journal of India was contributed on "the mechanics of tillage implements" and is, I believe, the first attempt ever made to reduce to graphs the feeling of the skilled west country ploughman when he has his "pleugh guid gaun."

Well Boring.—The staff of three supervisors and twenty borers maintained for the augmentation of water-supply in ordinary wells has fallen considerably under strength during the year, several borers being absent for considerable periods through illness, or what is probably more correct, ability to obtain higher pay elsewhere. Government has recently improved the prospects of these men and it is expected that this will result in a non-recurrence of the recent epidemic. Financial stringency still prevents the renewal of necessary boring plant and the fact that work has been carried on throughout the year reflects considerable credit on the well supervisors concerned. As might be expected results are not so high as compared with past years, but are well up to average and consider-

ing the conditions mentioned the results are not unsatisfactory. The total number of bores sunk amounts to 343 compared to 392 in the previous year; the percentage of success being 82·2. The number of borings in districts where strainers have to be used amounts to 72 as compared with 176 in the previous year. The reason for this reduction is mainly the demand for a larger size strainer and the almost prohibitive cost of these. It is for this reason that so much attention is being given to the production of a cheap and efficient strainer.

Tube Wells.—Enquiries received during the year for estimates and particulars of tube wells have not matured, chiefly on account of the still prevailing high prices of plant and machinery and a hope that there will be an early decline. At the present time three tube wells are in progress. Boring for the one in Bahawalpur State was carried down to a depth of 423 feet while I was on leave and considerable modifications have had to be made in its arrangement, causing great delay, this tube is now under test and is therefore practically complete. A second tube well at Dera Ismail Khan was started fifteen months ago and work delayed on account of non-arrival of plant from England—this tube is nearing completion and will be ready for testing in the next few weeks. Boring was commenced at the Gujrat demonstration farm nearly a year ago and has been carried to a depth of 173 feet, the soil passed through is non-porous and extremely difficult to bore with hand power, it is not yet known to what depth this boring will require to be made as similar strata have not, so far, been encountered elsewhere in the Province. The second tube well at Jallalabad has been completed and handed over to the Mamdot State. Nothing has been done to the tube well at the Veterinary College, Lahore, on account of financial stringency, and shortage of electrical energy. The strainer for this tube well was inserted while I was on leave and it is feared that when the work is again resumed considerable expense and delay may result in having abandoned work at the particular stage in which this tube was left. No work has been done in the past year on the College tube well as electric power is required to drive this well. A bore which may ultimately result in a tube well is being sunk at Makarwal for the Makarwal Colliery. The site for this bore was selected and work started and then the Colliery Company stated that they desired the boring to be done elsewhere, therefore, a second bore was commenced three miles distant from the first site, rock was encountered at an early stage in this bore and the work abandoned and re-started on the original site selected by this department. Boring is now well over 100 feet in depth, but sub-soil water level has not been reached, this is estimated at 190 feet. A tube well here, if successful, will prove of great benefit as water for domestic purposes has to be brought by rail at considerable expense and trouble.

Battery Tubes.—The high prices still prevailing for all plant and machinery, labour, etc., are causing landowners to wait before installing a tube well in the hope of prices falling. A single tube

well at the present time costs from twenty-five to thirty-five thousand rupees, according to the sub-soil conditions and with fuel prices still high the maintenance charges including interest on capital and depreciation amounts to thirty-five rupees and upwards per acre per crop. Even with good market rates for farm produce the land-owner hesitates in sinking a comparatively large capital and having to pay about six times the average canal rates for irrigation. If however lift irrigation can be brought within reasonable cost limits there is considerable demand for it and during the past few months I have gone into this question in great detail with the result that it is possible to deal with an area of thirty thousand acres under one scheme and bring the charges for lift irrigation from the sub-soil within economic limits.

Teaching.—In addition to the three hours engineering lectures which I have delivered to the third year students during the past seven years, lectures and practical field work in elementary land surveying were handed over to me during the past year, this course is given to all second year students in the college.

General.—Several minor works have been carried out by this section during the past year, such as the erection of a power cane crusher at Gurdaspur, experimental gins for the Economic Botanist, sugar making centrifugals at Gurdaspur, construction of various working models for exhibition purposes, etc. After more than seven years' experience of the Agricultural Department I consider that the investigation work carried out by this section during that period is of real use in the development of the country, and that the recent pronouncement of the Punjab Government "that they see no reason or justification for a research engineer" can only result in stagnation.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government,

Punjab, Lyallpur.

APPENDIX A.

WELL-BORING.

Serial No.	Name of District.	Wells.		Remarks.
		No. of bores.	Successful.	
1	Multan	22	18	Ludhiana Circle percentage of success 79·7. Out of 133 there were 5 trial bores, all of which were successful.
2	Ferozepore ...	34	27	
3	Lahore	47	39	
4	Ludhiana	12	7	
5	Muzaffargarh ...	18	15	
	Total ...	133	106	
6	Jullundur ...	20	17	Jullundur Circle percentage of success 85·7. Out of 147 there were 42 trial bores out of which 41 were successful.
7	Hoshiarpur ...	62	49	
8	Gurdaspur ...	7	6	
9	Gujranwala ...	1	1	
10	Sialkot	22	19	
11	Sheikhupura ...	8	8	
12	Amritsar	27	26	
	Total ...	147	126	
13	Gurgaon	16	16	Rewari Circle percentage of success 79·3. There was only one trial bore which was successful.
14	Ambala	7	2	
15	Karnal	25	20	
16	Rohtak	14	11	
17	Delhi	1	1	
	Tota ...	63	50	
	Grand Total ...	343	282	Percentage of success 82·2.

APPENDIX B.

Details of strainers used in wells in the Punjab.

Circle.	District.	Prior to July 1916.	Prior to July 1917.	Prior to July 1918.	Prior to July 1919.	Prior to July 1920.	Prior to July 1921.	Prior to July 1922.	Average yield of wells before strainer was used. Gallons per hour.	Average yield of wells after strainer was used. Gallons per hour.	Average cost per well.	Remarks.
											Rs.	
Jullundur.	Hoshiarpur ...	8	52	79	91	103	122	131	559	1,965	134	
	Amritsar ...	9	31	50	54	79	113	125	751	3,604	228	
	Jullundur ...	0	1	1	1	1	1	1	930	3,000	180	
	Sialkot ...	0	6	13	39	60	74	79	593	3,320	133	
	Gurdaspur ...	0	0	8	13	25	36	39	991	3,502	150	
	Gujranwala ...	0	0	2	23	28	41	41	615	2,361	146	
	Shahpur ...	0	0	0	0	0	1	...	...	1,000	125	
	Gujrat ...	0	0	0	0	1	1	1	545	1,925	137	
	Sheikhupura ...	0	0	0	0	0	0	3	690	3,500	300	
Ludhiana.	Ludhiana ...	9	14	20	30	41	48	49	401	1,891	163	
	Montgomery ...	4	16	16	16	16	16	16	630	2,600	150	
	Lahore ...	0	47	85	106	123	145	154	644	2,265	156	
	Multan ...	0	6	25	41	47	66	78	590	1,906	156	
	Ferozepore ...	0	0	7	21	31	36	41	841	2,679	129	
	Muzaffargarh ...	0	0	0	0	0	7	18	693	2,965	153	
	Bahawalpur ...	0	0	0	0	0	4	4	593	9,537	349	
Rewari.	Gurgaon ...	0	2	3	3	3	3	3	600	2,300	150	
	Karnal ...	1	3	5	25	52	70	72	607	2,661	103	
	Ambala ...	0	0	3	8	10	12	12	883	3,737	158	
	Total ...	...	...	...	...	...	...	868	640 Average	2,980 Average	168 Average	

APPENDIX—CONCLUDED.

Circle.	District.	No. of strainers.	Average yield of well before strainer was used. Gallons per hour.	Average yield after strainer was inserted. Gallons per hour.	Average cost per well.	Remarks.
		Since July 1921 to 30th June 1922.			Rs. A. P.	
Jullundur.	Hoshiarpur	9	400	1,300	135 0 0	
	Gurdaspur ...	3	950	3,200	150 0 0	
	Sialkot ...	5	550	1,800	135 0 0	
	Amritsar ...	12	900	4,000	600 0 0	
	Sheikhupura ...	3	690	3,500	300 0 0	
Ludhiana.	Ludhiana ...	1	625	2,356	125 8 0	
	Ferozepore ...	5	1,737	2,925	107 0 0	
	Lahore ...	9	794	2,962	130 0 0	
	Multan ...	12	956	2,256	174 0 0	
	Muzaffargarh ...	11	681	2,800	142 0 0	
Rewari	Karnal ...	2	Nil	2,456	160 0 0	

APPENDIX VI.

Report of the Professor of Agriculture, Punjab, Lyallpur, on District work for the year ending 30th June 1922.

During the year the area of the Lyallpur circle remained unchanged and included the Lower Chenab and the Lower Bari Doab Canal Colonies. Up to this year the work of the former colony was conducted from Lyallpur, its entire district staff being stationed there Similarly the Lower Bari Doab Colony was worked entirely from Montgomery. During the year under report it was considered that the activities of the Agricultural Department throughout these colonies could be very profitably increased by distributing the staff in various centres in them. At the same time this would cut down unnecessary travelling expenses in always returning to Lyallpur and Montgomery respectively. The appointment of new assistants to our staff enabled a start to be made in this direction and during the latter half of the year the staff was distributed as follows :—

No.	*Class of officer.*	*Centre.*
2	Agricultural Assistants	Lyallpur.
3	Muqaddams	,,
1	Muqaddam	Jaranwala.
1	,,	Samundri.
1	Agricultural Assistant	Multan.
1	,, ,,	Sheikhupura.
1	Muqaddam	,,
1	,,	Sangla Hill.
1	Agricultural Assistant	Jhang.
1	Muqaddam	,,
1	Agricultural Assistant	Khanewal
1	Muqaddam	,,
1	Agricultural Assistant	Chunian.
1	Muqaddam	,,
1	,,	Mian Channu.
1	,,	Okara.
2	Agricultural Assistants	Montgomery.
1	Muqaddam	,,

One of the agricultural assistants at Montgomery is in charge of the Seed Farm there in addition to doing some district work. Recently Bhai Puran Singh, who has been in charge of the District Board Farm at Raewind, since it was taken over by them in September 1920, has been absorbed in the Department as an agricultural assistant and remains stationed at Raewind, where in addition to running the farm he controls our work in that district.

The year was more normal as regards rainfall than the preceding one, the rains being if anything slightly above the average figure. For the wheat crop the season was good except during January and February when the weather was cloudy and some damage resulted from rust. The cotton crop, however, did not do so well. Desi cottons were more or less normal but Americans in the Lower Chenab Colony gave a very poor outturn. This was the case with both the varieties of American

cotton grown—4-F and 285-F. Of the two in this colony 4-F. was slightly better but in both cases the yields were very far short of normal. Some damage was reported from borer amongst Americans. The crop looked very promising up till August but during this month on poor land the leaves began to turn reddish brown and finally dropped off. Before the end of September even the best land seemed to become similarly affected. Rains in August and September produced much vegetative growth. These were succeeded by hot dry south-west winds in some districts. Boll opening was very poor, the seed to a very large extent quite unripe and imperfect and the lint weak. In the Lower Bari Doab colony, the American cotton crop did much better. Of the two varieties 285-F is the more favoured. Fair yields were obtained on the whole, especially in the Khanewal area which was the only district in the Lyallpur circle from which seed of the American varieties fit for sowing could this year be obtained.

Farms.

A detailed account of the experiments at the Lyallpur Agricultural Station is contained in a separate report. They include work on all the main crops—varietal, cultural, irrigational and manurial, together with reports on machinery trials, such as tractors and threshers. As regards the main crops it may here be mentioned that this year Punjab-8-A wheat showed a distinctly higher yield on the average than the older and now widely established type Punjab-11. A total of 93 experiments was made testing these two varieties against each other under all sorts of conditions. In 74 cases Punjab-8-A gave the higher yield of grain. On the average of all these experiments the outturns were : —.

	Mds.	srs	chks.
Punjab-11 ...	18	33	4
Punjab-8-A ...	20	17	4

American cotton on the farm did very badly and suffered from all the defects already mentioned. Of desi cottons G. I. mollisoni continued to do well and when tested against 4-F gave over 10½ maunds kapas per acre against just over 1½ maunds for the latter. The American crop being so poor this year the difference is of course abnormal. Of sugarcane varieties Suretha continues to keep the lead and indeed has further increased its produce this year, giving in one case over 90 maunds gur per acre. Seed of this variety is beginning to be much sought by zamindars and as much as was available was distributed to a few of them this year.

On the Montgomery Seed Farm many experiments were carried out during the year on all the principal crops, the object usually being to ascertain whether the results obtained at Lyallpur held good also for the Montgomery District. In wheats Punjab-8-A here also yielded more than Punjab-11 and was in addition better liked by the consumer. 285-F cotton did better than 4-F to the extent of slightly over 1 maund per acre, though the yields of both are low. Comparisons of Toria and Raya No. 3 showed an average yield of 16 maunds 6 seers for the latter against 12 maunds 9 seers for the former. This result is on the lines of that obtained at Lyallpur last year.

The Lahore District Board Farm, Raewind, continued to be run under the supervision of the Agricultural Department and the manager is now on our staff. The initial expenditure has all been incurred now and though the farm is small there is every hope that in the future it will be self-supporting.

The Co-operative demonstration farm in Chak 89/6R is running successfully. It is let out to tenants on the usual half share system. More than half the land was at first poor and *bari*. It is now gradually improving by good cultivation.

At the Jail Farm, Montgomery, demonstrations of improved implements, improved methods of sowing, etc., continue to be given to the convicts.

On the Narwala Reh Farm the amount of Kallar is still on the increase. It is now reported to have reappeared over an area of 32 kanals as compared with 18 kanals last year and 12 kanals two years ago. The canal authorities have agreed to give the proprietors the old arrangements for water supply.

A Co-operative demonstration farm has been started at Salarwala. Its area is one square. The land, is allotted on temporary lease for 5 years. Possession was taken in November last and some 10 acres of wheat were sown after clearing the jungle. Levelling will be done this year and regular work started next Rabi.

The demonstration plots in Chak 141/10R, 78/5R and 4/Khokhor Minor continue to do well and to be a source of much interest and instruction to the neighbouring zamindars.

Cotton.

In the Lower Bari Doab Colony the following quantities of seed were purchased for distribution :—

4-F American	3,592 maunds.
285-F American	365 „
Desi (G. I. Mollisoni)	9½ „
Desi (Rosea)	11½ „

There was a very keen demand for 285-F which is much favoured in this colony. The whole of its seed and that of the Desi varieties was disposed of immediately. The amount of Desi seed obtainable of any pure variety is very small and it is being multiplied as fast as possible, as there is a desire for it amongst zamindars. Of the above amount of 4-F seed 3,407 maunds were sold for sowing purposes. The demand for our seed was keen in Okara, Montgomery and Chichawatni Centres as local seed was of very poor quality but in Mian Channu, Khanewal and Jahanian, where local seed was fair our seed did not sell readily. It is considered that 9,000 acres are now under 285-F in this colony as against 1,604 acres last year.

At Lyallpur the following quantities of cotton seed were procured for seed :—

4-F American	...	3,000 maunds.
285-F American	...	50 „
Desi (Mollisoni)	...	10 „

Of the 4-F the various depôts throughout the Lower Chenab Colony to which it was distributed report the total sales for sowing purposes at 2,357 maunds. From the 50 maunds 285-F only some 23½ maunds have been issued for sowing to selected zamindars under seed farm conditions. This variety whilst it is growing in popularity in the Montgomery District does not seem to commend itself to the zamindars of Lyallpur. Of American cottons they unanimously prefer 4-F.

The seed of American cottons distributed last year for multiplication amongst the zamindars of the Lower Chenab Colony gave us no return owing to the partial failure of the crop. The seeds produced this year could not be purchased for sowing purposes as they were undeveloped and immature. All the seed for the whole circle had therefore to be obtained from the Khanewal District where the crop was better than in any other part of the circle.

The yields obtained by some of the large zamindars and Government grantees are interesting and are here given :—

Name.	*Variety.*	*Average yield.*		
		Mds.	*Srs.*	*Chks.*
Brititish Cotton Growing Association Estate, Khanewal.	4-F	7	32	0
Ditto ...	285-F	7	36	0
Ditto ...	Desi	10	9	0
Mr. H. T. Conville, Montgomery ...	4-F	4	0	0
Ditto ...	285-F	5	10	0
Oat Hay Farm, Okara ...	4-F	2	25	0
Ditto ...	285-F	4	0	0
Col. Cole, Koleyana ...	4-F	4	20	0
Ditto ...	285-F	4	0	0
S. Jagat Singh, Pirawalla ...	4-F	7	0	0
Ditto ...	285-F	7	20	0
Renala Estate ...	4-F	4	0	0
Ditto ...	285 F	5	10	0

Desi Cottons.—Owing to the poor returns got in many places from American cottons during the last three seasons the call for seed of a good variety of Desi cotton is becoming more and more insistent. Ordinary Desi as grown locally is a mixture of several varieties. So far the amount of available seed of any pure variety of Desi cotton is very limited, and we are increasing this amount as rapidly as possible particularly in the case of G. I. Mollisoni.

Cotton Auctions.—During the year six cotton auctions were held by the Department in this circle, two being in the Lower Bari Doab Colony and four in the Lower Chenab. Of the six sales four passed off well and substantial increases over local mandi rates were obtained for the zamindars, but in the remaining two cases the bidding was so poor that the lots were withdrawn. Altogether the total quantity of American Kapas sold at these four auctions was 21,590 maunds. The quantity is small as the yield this year was so poor. The market for American cotton is now well established and these auctions have finished their part. In future they should only be conducted in about two places with a view to securing seed.

Cotton in lines.—The acreage sown in lines continues to increase and the demand for assistance from our staff becomes more and more. Harrowing and hoeing with bullock drawn implements is increasing in popularity. The hoeing is generally done with the Horse-hoe or Lyallpur-hoe.

Wheat.—Under our pure seed distribution scheme the following quantities of seed were purchased this year.

	Punjab-11.	Punjab-8-A.
Lower Chenab Colony	... 3,449	... 340
Lower Bari Doab Colony	... 5,800	...

Of this 3,335 maunds were distributed for sowing purposes in the former colony and the whole 5,800 maunds in the latter. Owing to the very high price of seed at sowing time and the poor quality of much of the grain in the market there was a great demand for our seed.

It is impossible now to ascertain the area under pure Punjab-11 wheat. The bulk of the bearded wheats might be brought under this type and a very great amount of the wheat now on the market, though we cannot claim it directly, is descended from wheat given out by the Agricultural Department in former years.

In the Lyallpur Colony some wheat of type Punjab-8-A was given to selected zamindars for trial and report. More than half reported that it was better than Punjab-11 and the others were uncertain as to which was the better. All agreed that it was the better wheat for baking.

The returns given by some of the large landholders and grantees in the Lower Bari Doab Colony speak for themselves.

Name.	Type.	Yield.			Remarks.
		Mds.	Srs.	Chs.	
Seed Farm, Montgomery ...	Punjab-8A ...	25	8	0	
Ditto ...	Punjab-11 ...	22	37	0	
District Board Farm, Raewind ...	Punjab-8A ...	24	27	0	
Ditto ...	Punjab-11 ...	16	10	0	
Co-operative Farm, Montgomery ...	Punjab-8A ...	16	32	0	
Ditto ...	Punjab-11 ...	17	0	0	
British Cotton Growing Association Farm, Khanewal.	Punjab-8A ...	20	21	0	
Ditto ...	Punjab-11 ...	18	33	0	
Jahangirabad ...	Punjab-8A ...	16	0	0	
Ditto ...	Punjab-11 ...	15	0	0	
Oat Hay Farm, Okara ...	Punjab-8A ...	15	5	0	(Area 59 acres).
Ditto ...	Punjab-11 ...	18	24	0	(Area 5,067 acres).

As usual great difficulty was experienced in inducing the small zamindars, in the Lyallpur District, on whom we are dependent for the multiplication of our seed, to hand it over when we wished. Now that there is a fair prospect of our securing more land for a seed farm in the neighbourhood of Lyallpur, this difficulty will, we hope, soon cease to be felt and we shall be able to multiply seeds for distribution much more quickly.

Taccavi wheats.—As the time for sowing approached during the late summer and autumn, the scarcity of wheat for seed became much felt. Particularly was this so in districts where the previous crop had been a failure. Late in the season we received instructions to purchase large quantities of good seed and consign to such places as Hoshiarpur, Rawalpindi, Kangra, etc. For some weeks the energies of our entire staff were concentrated on this work. Much of the best wheat had by this time been disposed of and the task presented great difficulties. We were, however, eventually able to secure practically all the good seed that was required. The value of the total amount of this seed purchased and consigned by us to other districts of the Province was Rs. 1,24,264-13-0. Besides the taccavi wheat we also at that time procured and supplied 500 maunds of Punjab-11 to the Deputy Commissioner, Dera Ghazi

Khan and 444 maunds to Court of Wards estates in the Multan District. The work was carried through without a hitch and in addition to the normal work of the district staff. Letters of appreciation of the quality of the grain were received from some of the districts to which it was consigned.

Implements.—There was a falling off in the sale of improved country made implements during the year. This was due largely to railway booking difficulties. Previously our implements had been sent at railway risk with only the breakable parts packed. The railway this year refused to carry them at their risk unless all were completely packed. This was impossible in many cases. After much correspondence and personal interviews, the railway authorities have now agreed to accept the implements on the old terms. In spite of these difficulties 191 Bar harrows and 87 drills and hoes were sold. Certain villages now go in for using our improved implements entirely.

The keen demand for the imported Raja fodder cutters still continues. The Agents at Lyallpur during the year sold, 174 of which 167 went to this circle, this too with the price standing at Rs. 175. In addition we supplied 18 Simplex fodder cutters which were left with us for disposal by Messrs. Octavius Steel & Co.

The staff inspected 42 reapers during the harvest season and put them in working order. Six machines which could not be repaired in the villages were brought to Lyallpur and put in order. The sale of reapers is being seriously hampered by their present very high price.

Exhibitions and Demonstrations.—Demonstrations of improved implements were given during the year at the following places on the occasions of the annual fairs,—Lyallpur, Jhang and Shahkot and Sheikhupura district. One of the largest exhibitions ever given by the Agricultural Department was held by us in February at Lahore at the three days' Mela on the occasion of the visit of His Royal Highness the Prince of Wales. All implements recommended by the Department, whether country made or imported, were on exhibition. In addition practical demonstrations were given on each of the three days with most of the implements and included ploughing, cultivating, sowing, fodder cutting, etc. A new feature was introduced in the demonstration daily of cream separation and butter-making by the latest and most scientific methods. Both the exhibition and demonstration parts of the show were exceedingly well patronised every day and our staff was kept busy giving explanations and advice to interested enquirers.

Practical classes.—At Lyallpur two classes were held during the year for instructing zamindars in improved methods, use of improved implements, etc. The number of men who attended was 19. The classes are well spoken of and it is hoped that the attendance will improve. At Montgomery there seemed a demand for a class for instruction on reaping machines and we offered to hold such a class. No one, however, eventually desired to take advantage of it due to the present very high price of reapers.

Agricultural Associations.—During the year two meetings of the Lower Bari Doab Agricultural Association were held at Montgomery. Both meetings were exceptionally well attended. The zamindars take a practical interest in the Association which is flourishing. At Lyallpur also two meetings of the Lower Chenab Agricultural Association were held. The attendance here though good fell short of what could reasonably be expected. Both Associations are doing good work.

Acknowledgments.—I desire to record my thanks for their help and keen interest in our work during the year to B. H. Dobson, Esq., C.B.E., I.C.S. Deputy Commissioner, Lyallpur, and to F. H. Puckle, Esq., I.C.S., Colonization Officer, Montgomery. We are also greatly indebted to Chaudhri Bhagwan Das, B.Sc. (Agri.), Lyallpur, who is a past student of our College, for his very material assistance rendered to us throughout the year but especially during the days when the Department was purchasing wheat for distribution as taccavi. In this connection I desire here to thank every member of the staff who was engaged in this work. Chaudhri Muhammad Abdullah, then Extra Assistant Director of Agriculture, now Deputy Director of Agriculture, worked with unflagging zeal and energy to put through these large purchases in time for sowing. He and all the staff, both office and outside, laboured willingly from early till late day by day till the difficult task was successfully accomplished.

H. R. STEWART,

Professor of Agriculture, Punjab, Lyallpur.

APPENDIX VII.

Annual Report of the Deputy Director of Agriculture, first Circle, Gurdaspur, on District work for the year ending 30th June 1922.

THE magnitude in size of this circle remained the same as in the last year and work has been continued in the districts of Hoshiarpur, Jullundur, Amritsar, Gurdaspur, Sialkot, Gujrat and Shahpur on an extensive scale but general propaganda and seed supply has to a small extent been made in Ludhiana, Lahore and Gujranwala Districts as well. A similar number of district farms (experimental and demonstration) belonging to the Government, District Boards, other private institutions as well as zamindars as in the last year has been maintained and increased by one with the last named. They are as follows :—

1.	Government Experimental and Seed Farms.	Gurdaspur (Experimental). Sargodha (Experimental and Seed). Chillianwala (Seed). Kala Shahkakoo (Rice Farm).
2.	District Board Demonstration and Seed Farms.	Ludhiana. Jullundur. Beas (Amritsar District). Sialkot. Gujrat.
3.	Private Institutions ...	Khalsa College Farm at Amritsar. Borstal Jail Institution, Lahore.
4.	Zamindara Farms ...	Sardarpur and Kot Fazal Ahmad in Shahpur District.

For the sake of efficiency in supervision the circle has been divided into two divisions each under an Extra Assistant Director with head quarters at Gurdaspur and Sargodha, respectively. These officers have been entrusted with the district propaganda work alone under my supervision but all the farms have been kept directly under my own control. This enables them to devote a considerable time to tours in the districts and to come more in contact with the zamindars than heretofore. The first division comprises the districts of the circle in the Central Punjab and the second includes the Upper and Lower Jhelum Colonies and the remainder of Gujrat and Shahpur Districts.

The systems of propaganda were similar to those adopted last year and in addition to the maintenance of the farms they consist of:—

(1) Demonstration plots.
(2) Private demonstration farms.
(3) Concentrated attention to villages more inclined to receive help than others.
(4) Demonstration and sale of improved implements.
(5) Sale of pure and improved seeds.
(6) Machinery and Seed Depôts.
(7) Cotton auctions.
(8) Cultural and Storage experiments with potato crop.
(9) Agricultural Associations.

(10) Eradication of Water Hyacinth.
(11) General propaganda, *e.g.*, sowing in lines, thinning of cottons and their interculture, demonstrations at Horse, cattle, and other fairs, etc.

1. *Sargodha Division.*—On promotion to the Provincial Service Q. Sami Ullah, who took charge of this part of the circle with two Agricultural Assistants in each of the Upper and Lower Jhelum Colonies, continued work with closer supervision. Gujrat, the most backward district of the circle, has received full attention and an Assistant has been posted in each of the canal irrigated and barani areas. They, in consultation with the prominent and interested zamindars of the district, have been able to instil interest in some of the members of the Agricultural Association and it is hoped that their attendance at the meetings and interest in the field will now steadily increase. Shahpur District (with its Lower Jhelum Colony) is better in this respect and we are already well established here. The following is a brief report of the work done in this division :—

Free loan of agricultural implements and their sale.—In order to popularize our implements and to encourage the zamindars to adopt them as well as learn their use a large number of Government implements of sorts is given out to individual zamindars for a short period of time. They are entered in proper registers and frequently visited by the staff in order to train the persons concerned. The following is the list of implements thus given :—

Raja ploughs 26, Spring tined harrow 11, Meston ploughs 26, horse-hoes 6, Lyallpur-hoes 10, bar harrows 15, Rabi drills 8, cotton and maize sowing Markers with *nalis* 150, hand-hoes 2, Raja reaper 1 and Raja fodder cutter 1.

Almost all of these implements are liked by the zamindars but the Raja plough, the Meston, bar harrow, Raja reaper and the Markers are by far the most popular, and are in great demand. The zamindar who obtains such loans is always inclined to extend them as long as possible but when forced and being unable to purchase them for want of funds unwillingly returns them. This shows the usefulness of the implements concerned but for the serious drawback in their exhorbitant prices which have increased several times ever since the pre-war days. The Raja plough from Rs. 27 to Rs. 50 and the Raja reaper from Rs. 250 to Rs. 780 may be quoted as instances. Owing to the failure of the rabi 1920-21 and a similar fate of the following kharif the zamindar public was hard hit and thus could not spare funds for these implements. Despite this the following implements have been sold during the year as compared with those of the last :—

Names of implements.		*1920-21.*	*1921-22.*
Raja plough	...	31	6
Meston plough	...	107	130
S. T. Harrows	...	1	...
Raja fodder cutter	...	1	1
Drills	...	4	3
Bar Harrows	...	48	14
Raja reaper	...	...	1

Owing to a bumper rabi harvest of 1921-22 the labour scarcity was very acute and a general influx of labour from Rajputana was prevented by its local demand. Thus the loan of one Government reaper was greatly contested for but no purchase except one was made. High prices, poor pecuniary condition and non-co-operation have greatly hindered this line of work, but efforts are being made to solve the first difficulty by helping a local foundry at Batala, District Gurdaspur, which is capable of manufacturing good shares and complete Meston ploughs. Any other local enterprizing smith who seeks our assistance and advice in the manufacture of these simple implements is always encouraged.

Machinery Depôts.—Branch Depôts at Gujrat, Chillianwala and Sargodha, with their head depôt at Gurdaspur, have recently been opened in order to facilitate the sale of implements and their various parts. They will generally stock bar harrows, Meston and Raja ploughs, their Meston shares and the like. Last year the supply of the Meston shares could not satisfy the demand but sufficient number has been stocked this year to prevent inconvenience. If a call is made for an article not available in the local sub-depôt it is referred to the head-depôt and supplied from there but the firms are approached only if this too happens to be out of stock. Thus this work is carried out with more speed and less trouble than before.

Demonstration of implements.—An itinerary beldar with some implements on a cart was kept up during the year. A large number of such demonstrations was held in the barani "thal" of the Shahpur and newly colonized area of the Gujrat districts. The part played by the tenants on Government farms of Chillianwala and Sargodha is very great indeed. A stranger seeing them using a Raja plough with their own short sized local bullocks at once casts off his diffidence and is then easily convinced. Advantage is taken by making use of such tenants in propaganda work and they are sent out for sowing cottons in lines and to demonstrate the use of Raja plough, etc., with their own bullocks. A Mukaddam with big Hissar Government bullocks is not always as successful as a tenant with his own small bullocks.

Sale of pure and improved seeds.—This transaction is effected by the purchase of large quantities of selected wheat and cotton seeds stored at various places till autumn. The seed produced on the farms and from the crops grown by the zamindars from the last year's selected seed supplied by the Department is collected for distribution amongst new zamindars every year and thus its sphere is gradually widening. The zamindars' crops are carefully watched and thoroughly rogued out under the direct supervision of the staff. This ensures a pure seed, grown under favourable conditions and well suited for sowing purposes.

Seed Depôts.—As in the case of the implements several Seed Depôts have been opened up and scattered in the districts within easy access of the zamindars. They are situated at the following places this year :—

Sillianwali, Shahnikdar, Sargodha, Chak 33 S.B., Chak 81 S.B., Bhalwal, Bhera, Phularwan, Malakwal and Bahauddin, but arrangements

are in hand to open similar depôts in the barani portions of the districts at Shahpur, Lalamusa, Kharian and Gujrat. Thus easy access and the least trouble to the zamindars have always been kept in view. However, a serious drawback in increasing the numbers of such depôts is felt in complicated prescribed forms for keeping their accounts and this is often a footfall for an agricultural assistant not conversant with account matter. A wholetime clerk with each agricultural assistant will probably solve the trouble.

Wheat.—Punjab-11 is rapidly being ousted out by 8-A of which large quantities are stored for seed every year. Last year owing to a very scanty harvest not more than 4,455 maunds of 8-A seed could be purchased for storage by the Department. But at the sowing time the demand was so great that all this was disposed of in no time. There was in all about 12,000 maunds of 8-A seed available in the Lower Jhelum Colony, of which some 10,000 maunds were used for seed during the rabi 1921-22 covering about 21,000 acres under 8-A wheat. The last rabi being very good about 6,500 maunds of this seed has already been stored and arrangements for more are still being made. In addition 25,000 maunds has been stored with the zamindars for the same purpose thus the area under 8-A next year will be very large indeed.

Punjab-11 though of secondary importance to 8-A still occupies some 6,000 to 8,000 acres in the Lower Jhelum Colony alone, but owing to bad eating qualities it is being gradually given up. Its growers used to grow a little of their beardless wheat for home consumption and send all the Punjab-11 to the market. But since 8-A has fulfilled both requirements of eating as well as fetching a premium of annas three in the market like Punjab-11 it is steadily becoming the favourite.

A note of warning must be sounded with regard to 8-A. Since its introduction in the colonies it has changed its colour from bright amber to mottled white. This is a serious factor as amber wheats always fetch higher prices in the market than the white, but it seems that 8-A grown under favourable conditions with varying amounts of irrigations has changed its outward appearance and this will probably demand the Department's serious attention in the near future.

Cotton.—This crop like that of the last year was a partial failure. Heavy rains of July and August produced large vegetative growth and the later showers hindered free flowerings. Some localities of the Shahpur District were swamped out which completely annihilated the crop. But in the canal colonies absence of irrigation during September and October gave the finishing touch. American cotton is very sensitive to land and water and it has been proved that it should not be grown except on fairly rich soils. The causes of its failure lay mainly in the poverty of the soils and want of last irrigation. Another factor lies in its seed which owing to crossing has no longer remained pure. The irrigation difficulties will always remain as long as toria is largely sown, as during August and September the zamindar has to sow his toria,

irrigate land for wheat and at the same time his American cottons demand the water. Thus he is unable to attend to all and often leaves cotton to its fate. On the other hand the question of this last irrigation with Desi cottons is not so acute nor do they demand a very rich soil. Therefore a zamindar is always advised to sow only as much American cotton as he can easily manage under the existing conditions and not to totally neglect Desis. A leaflet to this effect has already been issued by the Department.

Sowing of cotton in lines.—Last year 12,000 acres were sown in lines, but this year the number has been increased by 200 acres more in the Lower Jhelum Colony Start has only this year been made in the Upper Jhelum and 400 acres have thus been sown. Unless careful interculture follows, sowing in lines is of little use and therefore the attention of the staff is always fully occupied in visiting these areas, having them thinned and properly hoed as it is only under these conditions that it gives an increased yield over the broadcast sowing.

Cotton Seed.—The Upper Jhelum Colony, newly cultivated and yet fairly rich, gave the best American cotton crop in the Province. Therefore arrangements for the seed were made only from here, and some 3,584 maunds were purchased and stored in our seed depôts. Though this quantity was small and the indents from Lyallpur, Hansi and elsewhere were in hand, no more seed could be arranged for owing to mixtures. Only 30 maunds of pure strains of Desi varieties could be available this year from various farms in the central districts and Hansi and have been grown for seed distribution next year. Fifty acres under 285-F American cotton have also been grown for seed purposes.

Departmental and District Board Farms.—There are three farms in this division at Sargodha, Chillianwala and Gujrat besides the two with private zamindars. For Sargodha a separate report has been submitted.

Chillianwala Seed Farm.—This consists of 10 rectangles situated in the heart of the Upper Jhelum Colony. One-and-a-half rectangles are under direct cultivation by the Department and the rest are allotted to tenant on half batai. It is essentially a seed farm and no experiments except environment test of some new wheat, cotton and sugarcane varieties on the area under direct cultivation are carried out. Difficulties are still being felt in the absence of a pucca bullock byre implement shed, Agricultural Assistant's quarter and the office. 8-A wheat and 4-F American cotton are largely grown for seed but this year 50 per cent. of the cotton area has been put under 285-F, which is another very promising variety of the American cotton. Twenty maunds of cotton seed and 400 maunds of wheat seed besides the tenants' shares were obtained from the farm and distributed. There was an income of Rs. 8,952 against an expenditure of Rs. 4,461 of the farm during the year under report.

Gujrat District Board Farm—A total area of some 50 acres partly irrigated and partly barani is maintained for demonstration and is entirely the District Board property. The soil is underlaid with a stratum of almost pure sand at variable distances of 1-4ft. from the surface and therefore considerable money, time and patience are required in its reclama-

tion. But unfortunately the District Board is short of all—hence the progress has been very limited. However reclamation by means of cultivation and green manuring and installation of a tube-well for which Government allotted Rs. 17,500 continues and I am glad to record that some fields have already improved considerably. Even under such circumstances there was an income of Rs. 1,337-2-9 against an expenditure of Rs. 2,259-15-9. But owing to adverse weather conditions prevalent during the year the failure of the barani kharif and poverty of the soil account for the loss. A scheme of intensive farming on a small scale has this year been introduced and if all goes well the farm will become self-supporting next year.

Private Farms. 1. *Sardarpur.*—This farm has been started with a big landlord in the Shahpur Inundation Canal area where ignorance prevails and cultivation is of the poorest type. This is the first complete year of its existence under the management of a mukaddam lent by the Department. He in addition to the farm is entrusted with the district work as well and it is gratifying to note that his presence is now being known, and enquiries with regard to implements and seeds are beginning to be made. The farm has already served its purpose : cottons of the village are almost all sown in lines and only one strain of pure 8-A wheat was grown this year. Income and expenditure are as follows :—

	Rs.	A.	P.
Initial expenditure	551	7	0
Recurring „	979	12	0
Total ...	1,531	3	0
Income	2,062	14	0

2. *Kot Fazal Ahmad.*—The work here has only been recently started, but the place is situated in a backward portion of the Lower Jhelum Colony at the brink of the Upper Jhelum on Phalia side. Two squares of land have been reserved under the present conditions and it is proposed to introduce our cotton and wheat seeds as well as improved implements ; so that this area becomes a model farm in itself. The progress will be discussed next year.

Cotton auctions.—They were held at the following centres :—

Upper Jhelum Colony ...	Bahauddin.
	Malakwal.
Lower Jhelum Colony ...	Phularwan.
	Sargodha.

No second sales could be held at Bahauddin and Sargodha owing to rains and the scanty staff left and for the same reason the Sillanwali and Bhalwal auctions were omitted this year. These

functions are at present the only useful means of obtaining pure cotton, seed and almost all the seed purchased was from the first two auctions.

The system of receiving telegrams quoting the Bombay prices per kandy of kapas, was, on account of financial stringency, discontinued this year, except for auction days which was not satisfactory. The cessation of such telegrams has not been so much detrimental in big markets, where the purchasers are many and all of them well informed of the current prices to compete with each other. But in small markets like Bahanddin the limited number of buyers joined hands and kept down the prices on account of the ignorance of sellers. Proposals to mend matters have already been submitted to Director of Agriculture.

11. Gurdaspur Division.—On promotion to the Imperial Service, M. Fateh-ud-Din was replaced by M. Mukhtar Nabi on 3rd January 1922, who has since held charge of the Extra Assistant Director of Agriculture of this part of the circle. Each district has got one Agricultural Assistant who, in addition to running the farms, carries on the district work as well with the help of an adaquate number of mukaddams and beldars.

Demonstration plots.—This is the most important type of propaganda work in this division and has now been extended to almost every district. The plots are of two kinds—

(*a*) Cultural, where the use of improved implements and proper methods of cultivation are demonstrated, and

(*b*) Seed, where improved types of wheats are grown side by side with the local types for comparison. The test in both cases are made in the same field and entire work is done by the zamindar himself directly under the advice of the Department. There was a total number of 100 of such plots distributed as follows : —

Jullundur and Hoshiarpur	19
Gurdaspur	40
Sialkot	31
Gujrat, barani area only (Sargodha Division) ...	10

Except for Gurdaspur, where some plots are 4 years' old the others have only this year been started. The 4 years' old plots in Gurdaspur are being given up this year as an experiment to see if the zamindars concerned can continue to practise what they have learnt during this time. In their places plots have been started at quite new places.

Concentration of attention in some villages.—This is a new line of propaganda and consists of selecting two or three villages in each tahsil of a district where the zamindars are inclined to take advice and are likely to adopt every reformed scheme in farming. This advantage is to be fully utilized and attention is to be concentrated in such villages with a view to converting the whole place into a model of scientific husbandry. This does not preclude other villages or other zamindars from seeking advice or receiving full attention of the Department.

Demonstrations and sale of improved Implements.—The itinerary system of implements on a cart was continued and the following demonstrations were held :—

Sialkot fairs	6
Hoshiarpur Cattle fair	1
The Amavas mela at Tarn Taran, district Amritsar ...	1

and the following implements were sold by us during the year :—

Meston ploughs	1,287
Raja ploughs	6
Raja fodder cutters	1
Bar harrows	5
Single wheeled hand-hoes	4

In addition to these the following is the list of various implements and machines purchased direct from the firms by zamindars in this division:—

Centrifugal pump	7
Raja fodder cutters	4
Chattanooga plough	1
Oil Engines	6
Raja ploughs	15
7 S. T. harrows	4
Meston ploughs	3
Cane crusher	1

Machinery Depôts.—Under the principal Depôt at Gurdaspur sub-depôts have been opened at Jullundur, Beas and Sialkot which will in future facilitate sale of spares of sorts and Meston ploughs in particular.

Sale of pure seeds.—Similar methods of roguing and inspecting the crops for seed, its purchase and storage as in the Sargodha Division have been practised. The main crop handled in this Division is wheat, there being no cotton grown on any large extent. But its place was this year taken by chari of which very large quantities were sold during the last kharif.

Wheat.—8-A has proved to be the prominent type here too under all conditions of chahi and barani. Therefore its seed is scattered wholesale every year, but owing to its scarcity last year only 948 maunds could be procured for sale in the central districts and 100 maunds of pure 8-A was supplied to Sialkot from Sargodha.

The previous rabi had failed and there was practically no wheat seed for sowing purposes in the central districts ; as even for home consumption the population depended on the imported Australian wheat. Government therefore allotted Rs. 89,500 for what arrangements could possibly be made, and with great effort some 10,000 maunds of all kinds of mixed wheats fit for seed were purchased from the Lower Jhelum Colony and brought to Gurdaspur for final distribution mainly in Hoshiarpur and Sialkot and to some extent in the Gurdaspur Districts. This whole trans-

action though charitable in itself saved quite a lot of land from lying waste for want of seed and also fetched a profit of Rs. 7,000 to the Government.

Seed Depôts.—Similar to those in the Sargodha division some depôts are being opened up in the central districts and will soon be brought into use.

Chari Seed.—In February 1921 the scarcity of chari seed in the central districts for the following kharif was felt and arrangements were made to import large stores from Mianwali, Bahawalpur and elsewhere. Special staff was deputed and about 5,000 maunds were collected. Some of the acute shopkeepers also saw the chance and brought in a few wagon loads. They were selling it at Rs. 15 per maund when our supplies at Rs. 7 turned tables and this measure was thankfully appreciated by the rural public. All previous supplies were sold off by the middle of August, when under Director of Agriculture's orders some more was imported, but as the sowing time had past by the time it arrived the sale was very small and there is still about 1,000 maunds left.

District Board and Departmental Farms.—Besides the Gurdaspur Agricultural Station for which a separate report has been submitted there are four District Board Demonstration farms in this division at Ludhiana, Jullundur, Beas, and Sialkot; a departmental rice farm at Kala Shah Kaku and two private farms at Khalsa College, Amritsar, and Borstal Jail Institution, Lahore. Ludhiana is still without an Agricultural Assistant and no direct work has yet been started. It is being managed by a gardener under the direct supervision of the Secretary, District Board. I occasionally visit and advise.

Jullundur District Board Farm.—Out of the total area of 55 acres only 40 acres are culturable, the rest being pure sand. Laying out has been finished and this is the first complete year of its cropping. The sandy Tibbas have blowing sand one to four feet deep and efforts are being made to bind it together by means of Organic matter. But all this portion is barani and therefore the progress is rather slow at present. Out of the culturable portion 6 acres have have been allotted to the School Agricultural Centre for teaching purposes without any return whatsoever, thus the real farm is badly crippled. However it has done very well during the year and has grown varieties of sugarcane, Desi cottons and wheats for demonstration and seed distribution next year.

Besides demonstration of implements and new crops this farm has undertaken cultural experiments with potatoes. This consists of growing the crop by means of bullock hoes and their interculture and harvest is also done by bullock implements as compared with that under the local method with manual labour. The idea of the experiment is to solve the labour difficulties and to save money in its cultivation. The experiment this year has been very encouraging and though in the absence of a

potato digger the harvesting was done by hand, the saving in money is considerable :—

Treatment.	*Area.*			*Cost of sowing.*			*Cost of hoeing and earthing.*			*Total expenditure per acre.*		
	Acres.	Kanals.	Marlas.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
Machine ...	4	17	7	5	0	0	10	12	0	33	12	0
Local Desi method.	2	13	7	11	11	0	36	0	0	205	0	0

The machine method produced 46 maunds more than the local method, and if these results are confirmed next year the methods will be demonstrated to the local potato growers.

Besides wheat, cane, cotton, minor crops like groundnuts, bajra, Japan rape and fodders were also grown on the farm.

Income and expenditure.—Though the area under proper cultivation is only 20 acres the farm has given a profit of Rs. 496-4-9 this year by means of intensive cultivation. There was an income of Rs. 2,564-13-6 against an expenditure of Rs. 2,068-8-9.

Sialkot District Board Farm.—This is the best farm of its type and the land is fairly good all through, partly under well irrigation and partly barani. This has also grown various varieties of sugarcane, cottons (both Desi and American) and wheats with excellent yields. Besides its ordinary functions of seed and demonstration this farm also conducted potato cultural experiments as in the case of the Jullundur Farm. The results here too are successful.

Treatment.	*Area in acres.*	*Outturn per acre.*			*Expenditure incurred.*			*Income fetched.*			*Net profit.*		
	Acres.	Mds.	Srs.	Chs.	Rs.	A.	P.	Rs.	A.	P.	Rs.	A.	P.
Machine ...	½	121	10	0	207	12	0	288	4	0	80	8	0
Local Desi method	½	107	10	0	235	10	0	255	9	0	19	15	0

Besides the cultural experiments some varieties of Scotch potatoes have been introduced for trial.

Income and expenditure of the farm.—There was a total income of Rs. 4,717-2-3 against an expenditure of Rs. 4,622-12-6, leaving a net profit of Rs. 94-5-9. The expenditure is heavy owing to the purchase of bhusa worth Rs. 300 and the payment of Rs. 285 the price of the bullock as a special case.

Beas Farm.—This farm like that at Gujrat has not yet fulfilled its objects. Under the Director of Agriculture's orders it has been taken over from the Amritsar District Board, and there being no separate budget, the expenditure has so far been met from the demonstration funds. There is

only one well and that too can give very little flow of water and therefore the major portion of the farm is barani. Owing to a scanty rainfall, *viz.*, only 12·45 inches the laying of the barani area could not be completed, hence the whole area of 43 acres has not yet been cropped. The laying out has now been pushed on as best as possible and a somewhat intensive scheme in order to make the farm self-supporting has this year been drawn up. The absence of buildings of any sort is a great inconvenience, and unless the farm staff can reside on the spot the success of the farm is doubtful. Some varieties of canes, wheats, and cottons as well as bajra and gram on the barani area were grown which gave an income of Rs. 1,187-13-10 against an expenditure of Rs. 2,314-7-9 including Rs. 250 as extraordinary expenditure incurred on boring the well for increasing its water supply though without success and purchase of bhusa.

Kala Shah Kaku Rice Farm.—No work has yet been started and for want of a trained Assistant it has again been leased out for one year.

Private Farm. 1. *Khalsa College Farm.*—The farm has been divided into three blocks, two under tube-well irrigation and one barani. The latter includes a good many brick-kilns and therefore the laying out has not yet been completed. The two irrigated blocks have been handled and are under proper cropping scheme. My functions here are purely advisory and I am glad to record prompt attention and compliance with all my recommendations and suggestions. Besides a small area for growing vegetables for the college students and staff a few acres have been reserved for "students practising area" where actual handling of various implements is taught. Besides its instructional value the farm has fetched an income of Rs. 4,738 against an expenditure of Rs. 3,738, thus giving a net profit of Rs. 1,000 to the College.

Borstal Jail Institution Farm.—This farm is yet in its infancy. The land taken over was nothing but ditches and hillocks. A good deal of levelling with convict labour has been done and two blocks of flat land have now been made and a few vegetables grown for the first time. The levelling still continues.

Potato storage experiment at Sialkot.—This work has been fully discussed in previous reports, and suffice it to say that this year the experiment was concluded and a leaflet embodying the main points for the benefit of the potato growers has been drawn up and distributed.

Eradication of Water Hyacinth.—This pestilent weed has very widely spread in the Gurdaspur District and is drying up and infecting all water reservoirs. Not only this, it is gradually finding its way to the rice fields which would bring a sure disaster to the crop. It is therefore very urgent that its progress should be checked The District Board was approached for funds. But their inability to meet the request brought in Rs. 500 from the Government, and an Agricultural Assistant with some saff was deputed to eradicate this weed. With the limited means and without much co-operation of the public he could only treat about 20 ponds within a radius of 10 miles round the Gurdaspur town but the treated ponds have been thoroughly freed from its pre-

sence. Propaganda against the weed is being carried on and the question is constantly brought up at the meetings in order to seek general co-operation of the villagers without which a complete eradication is impossible.

A revised leaflet on the subject giving photographs of the methods of eradication is being issued.

This weed was observed from the train when crossing the Palkhu Pond near Wazirabad and the Deputy Commissioner, Gujranwala, was requested for funds. Prompt orders to local officials and the deputation of our Agricultural Assistant, who has been provided with funds, will soon clear this and some other infected parts of the district as requested by the Executive Engineer, Canals.

Agricultural Associations.—These bodies are doing well in every district and each held two meetings as usual during the year, though in some cases the attendance was meagre. It is therefore proposed to dispense with the non-interested members and select new and real zamindars who till the land with their own hands. Revised lists have been drawn up and will be put before the next meeting for approval.

Staff.—The two Extra Assistant Directors of Agriculture, M. Mukhtar Nabi and Q. Sami Ullah, have taken up their duties with a great deal of zeal and have worked very satisfactorily. They have shared a considerable pressure of the ordinary office routine and maintained efficiency and control over district work. Of the office establishment M. Barkat Ali, Head Clerk, and Lala Manohar Lal Accountant, have given every satisfaction, and under the former's guidance the latter has cheerfully borne the heavy office routine.

SULTAN ALI,

Deputy Director of Agriculture, Gurdaspur.

APPENDIX VIII.

Annual Report of the Deputy Director of Agriculture, II Circle, Hansi, for the year ending 30th June 1922.

1. *Introductory.*—I took charge of this circle on 22nd December 1921 when Sardar Darshan Singh proceeded on 5 months' leave, which was later extended to 8 months; from 25th January 1922 to 18th March 1922 I was on special duty in addition to mine own in connection with the Provincial Mela held at Lahore during the visit of His Royal Highness the Prince of Wales, where besides helping in the arrangements generally I had to arrange an Agricultural Exhibition and demonstration of improved machinery.

2. This circle which forms the south-east of the Province, comprises six districts—Ambala, Karnal, Gurgaon, Rohtak, Hissar and Ferozepore. Active demonstration and propaganda work is going on more or less in all the districts, but is greatly limited owing to paucity of staff and it was due to this reason that the demonstration work had to be limited to :—

Ambala and Jagadhri Tahsils in the Ambala District.

Karnal and Panipat Tahsils in the Karnal District.

Gurgaon Tahsil and Palwal Sub-Division in the Gurgaon District.

Hansi Tahsil in the Hissar District.

3. In Ferozepore and Rohtak only our work is well developed and well spread, due partly to the help and the interest taken by their District Boards. There is of course a great deal more to be done here: even and with more staff we could expand more, all the same the present progress of work in these two districts is very satisfactory.

4. Delhi Province is also included in this circle for Agricultural work and the District Board has been approached to engage a demonstrator for their district.

5. The area comprising this circle is more than that of the same number of districts elsewhere in the Province, the problems offered so many and the field for improvement so wide that unless more sympathy in the shape of finance and staff is shown to this circle than has been its share in the past, I am afraid most of our energies will be wasted. The selection of superior varieties of crops, the distribution of their seeds, and the introduction of improved implements and of the results of the cultural methods obtained at our farms, will not bring forth results that are expected of them, unless accompanied by a vigorous campaign of demonstration and instruction in the villages.

In most parts of this circle the people are lazy and slow to pick up Agricultural improvements. The holdings are extensive and cattle rearing and also cattle lifting share with Agriculture their profession and attention. The big landlords and Jagirdars generally more than follow their brethren elsewhere and take little interest in the improve-

ments of their lands and agriculture. The petty farmers are in the hands of the bania, who removes most of their produce from the threshing floor and keeps them at his mercy till the following harvest. They have no choice in the disposal of their produce and thus very little interest as to its quality. Spirit of thrift, enterprise and progress is therefore wanting. These people need lot of patient teaching to be converted, and only good, well trained, efficient and sympathetic staff can do that.

Season and its effect.—Rains started late, and there were no early sowings of cotton, etc., in the baranis, but the monsoon though a bit late was generally good throughout, resulting in good kharif especially fodders and sugarcane. The rain in October was very timely and was responsible for the so extensive sowings of rabi (especially baranis) but the late winter rains failed generally in the Ferozepore and Hissar Districts and here the barani crops were very poor. In parts only of Rohtak there were some winter rains and barani crops in such places were good, but elsewhere the baranis were below average, similar was the case in Gurgaon. There were good and well distributed winter rains in the Ambala and Karnal districts, where consequently the rabi crops were generally good and above average.

In canal irrigated tracts the canal supply (except in June) was generally adequate, and canal crops both kharif and rabi were good everywhere.

The western winds were early this year and rather fierce and dry and did a good deal of damage to the maturing rabi. The grain was shrivelled and the outturn considerably reduced in all classes of soils. My own estimate is that but for these dry winds the outturn would have been 15 per cent. better.

The October rains though so beneficial for Rabi sowings took its toll in some other form, and damaged cottons in Rohtak and Hissar, and also bajra and jowar in Ambala and Karnal where fertilization was interfered with, resulting in almost barren heads.

Crop Pests.—Maize borer was very bad in Ferozepore and almost annihilated the maize and jowar crops in that district. Early crops on inundation canals only escaped this attack. The Government Entomologist with his usual promptness has started a campaign against the pest early this season.

Striga.—A root parasite in sugarcane was reported from the Karnal District.

Cutworm—was very bad in parts of Gurgaon, Rohtak and Hissar.

Rust.—A good deal of damage has been reported from rust in barley from Gurgaon. The Economic Botanist has been asked to suggest some rust resistant type. Rust was also reported bad in wheats in parts of the Ferozepore District and the Kharar Tahsil of the Ambala District.

Red Rot.—In canes of the Ferozepore District *Red Rot* is being successfully attacked by planting disease free and healthy sets only.

Earcockle in wheats.—Earcockle is doing considerable damage in the Karnal District. Demonstration plots were therefore arranged in collaboration with the Economic Botanist to show that the cure for this disease was only preventive and very simple and easy, and at the same time so effective. It was to sow clean seed only. The demonstration was very successful and had a very convincing effect on the neighbourhood. It will continue on a large scale next year.

Agricultural Farms.—There are four Agricultural farms in this circle.—(1) Hansi Government Experimental Station, (2) Rohtak District Board Demonstration Farm, (3) Jallalabad Estate Demonstration Farm and (4) Guruharsahai Estate Farm. The last two are in the Ferozepore District.

Hansi Agricultural Station—The detail of the experimental work in progress will be found in a separate report. Very successful work on cottons and wheats is in progress here. The situation of the farm and soil however are very great drawbacks and will never allow this place to be so useful as it otherwise could be. It is very inconveniently situated and attracts few visitors, officials or non-officials. It can however serve a useful purpose as a seed farm for cotton, for which seed there is such a great demand in this locality. It was with this object that proposals were submitted for the extension of this farm, by the addition of 10 rectangles of Government waste adjoining it. Pending orders of transfer this new area has been leased for a year for seed growing.

White Flowered Neglectum Bh. S. cotton and wheat type 8-A have so far given good results on this farm and are recommended. Cotton work on this farm holds out very good promise and it is expected to give out after a couple of years' trial a better type of cotton than even the present selection. The lint of the present selection is over 38 per cent., but some of our new selections have given a lint percentage of 40 to 45 per cent. Their trials on field scale are now in progress to ascertain their outturn per acre. The White Flowered Bh. S. which is now distributed for seeds beats all other Desi types in yield and lint percentage and compares very favourably with the best of the Americans. The keen demand for its seed by the growers and for its Kappas by exporters and others in the cotton trade and the premium (it was Re. 1 per maund of Kappas last year though the quantity was not very great) that it fetches in the market without the usual hagglings for a similar premium for Americans elsewhere are doubtless a direct evidence of the success of this selection.

Rohtak District Board Farm.—It is a demonstration farm of 40 acres. Part of it is irrigated and the rest unirrigated. The farm being at the tale end of the watercourse and the lead from the head being very long, the supply is generally very defective and very poor. No experimental work is done except to corroborate and demonstrate the results of experimental work at other places which are regarded beneficia-

for this district. The farm therefore carries on mostly cultural and varietal trials of crops to demonstrate the superiority of the departmental seeds, implements and methods of cultivation to the local ones in vogue. The only experiment of any interest here was the seed rate experiment. The local seed rate of wheat in this district is absurdly high, varying from 40 to 60 seers per acre. Experiments were therefore laid out last year to find out the best and the economic seed rate for this tract. Seed was sown at the rate of 25, 30, 35, 45 and 55 seers per acre. The experiment was duplicated. The results show that in well prepared seed beds 25 seers per acre is quite enough while otherwise 35 seers gives the best results and is quite safe. The financial results of the farm are :—

			Rs. A. P.
Expenditure	...	...	1,883 9 9
Income	...	...	1,979 0 0

Considering that a demonstrator on Rs. 25 per mensem forms part of this expenditure (no body owning a similar small area will entertain such a highly paid labourer) and that the last year was one of the worst ones for this place and even fodder had to be purchased for the farm cattle, the results are very good.

The farm is doing very useful propaganda work and this usefulness is admitted by the District Board, who are to be congratulated on the interest they take in the welfare of their district.

Jallalabad Estate Farm.—It is a similar demonstration farm as the Rohtak Farm but serves in addition as a seed farm also. The area is one hundred acres. The expenditure during the year under report was Rs. 4,699-3-3 and the income Rs. 10,941-1-0 giving a net profit of Rs. 6,241-13-9. It is the best managed and most successful demonstration farm in the whole of the province and the management of the Mamdot Estate is to be congratulated on the interest they take in its prosperity. The Department is indeed indebted to them for all the help that is always readily given in its activities.

Guruharsahai Estate Farm.—This farm has been reported by the Estate office to have given Rs. 202-15-0, as net income, but no details have been supplied. The farm was once during the year under report abandoned owing to certain changes in the management but has again been seriously taken up by the new manager. I hope it will prosper and do better in the coming year.

Besides proposals for demonstration farms at Karnal and Gurgaon are on foot and are awaiting funds for accomplishment.

These small district farms are very important for the progress of the work in that area and the want for them is keenly felt. They are essential as farming centres of our activities and nucleus of our work in that district. Well conducted farms of this nature do more to attract people to the Department than most of the wanderings of our assistants. There must be at least one place in the district where a farmer can go to, seeds and implements besides, for advice as he would go to a

dispensary if he is unwell, or to a veterinary hospital if his bullock is ailing. Demonstration farms should be the centres of all district Agricultural work, centre of our seed distribution, centre for the sale of improved implements, the place where remedial and preventive measures against crop pests are explained to him.

District and Propaganda work.—The other branches of the work are the same as last year, the main being :—

(1) The propagation and distribution of improved seed.
(2) Demonstration of improved implements.
(3) Demonstration of improved methods of cultivation.
(4) Demonstration plots demonstrating :—
  (*a*) Superiority of improved seeds.
  (*b*) Superiority of improved implements.
  (*c*) Cultural methods found successful on experimental farms.
  (*d*) Improvement of soil by green manuring, etc.
  (*e*) Eradication of grasses by the use of furrow turning ploughs, etc.
  (*f*) Sowing of crops in lines.
(5) Advice to the public.

Crops and Seeds.—Cotton and wheat are the two main crops on which work of some importance has so far been done and their improved seeds are at present distributed on a large scale. Other seeds too, like bajra, jowar, sugarcane, lucerne, oats, Japan rape, rice, groundnuts are supplied but in very small quantities as these crops have not so far been seriously handled anywhere in the Province. Jowar and bajra being very important for this circle systematic work on these two crops has been started on the Hansi Farm this year; similar work has also been started on sugarcane and varietal trials and cultural and manurial experiments laid out.

CROPS.

Cottons.—This circle excepting parts of the Ferozepore District does not offer any great scope for American cottons for reasons given in the last annual report. Desi cottons do better here, and Sardar Darshan Singh has wisely given more of his attention to them. His selection, White Flowered Bh. S., is very popular and is in great demand (please see above under Hansi Agricltural Station). There were 18,210 acres under this seed in the year under report. 2,235 maunds of this seed has been distributed this year (1922) by the Department and the area under this type from our own seed and that kept and distributed by the last year's growers is estimated to be double than what it was last year.

Efforts have been made and fairly successfully too to grow this seed only in the neighbourhood of our farm at Hansi to ensure a good supply of pure seed to outsiders, but the arrangements for securing this seed will remain as defective as before as long as our own ginning

installation is not put up. The gins are lying at the farm awaiting masonry structure to be erected. I hope funds will be forthcoming from somewhere to see this very important work through. But for this defect we would have secured a much larger quantity of seed last year and would not have disappointed a large number of our growers and outside orders.

Wheats.—Type 8-A has given very good results on our experimental and demonstration farms and is recommended as a general wheat for all classes of soils in this circle. It has done well everywhere except in Ambala Khadar, where Punjab-11 and Pusa-12 are preferred. The area under this type during the year under report was 10,357 acres, and 11,300 maunds of seed has been secured for the next crop. This is besides the 25,000 maunds which the growers are keeping for themselves and for sale to their neighbours.

Next in yield come the local types 14 and 16. Pusa-12 which has been superseded by 8-A in most places still continues to be a very popular wheat on well irrigated lands especially in the neighbourhood of Panipat, where very high yields are reported from this type. It responds more to better conditions of cultivation and moisture than any other of our types and there is no doubt that under such conditions it can seldom be beaten.

16-A.—Another of Mr. Milne's selections promises well for baranis, but is still under trial. It is a white grained type and if successful will speedily replace Punjab-14, a red grained wheat.

Sugarcane.—It is a very important crop in the Karnal, Rohtak and Ambala Districts, and in the Palwal Sub-Division of Gurgaon, but for want of a proper place little work has been done on this crop in the circle so far; but systematic experimental work has now been started at the Hansi Farm.

A few types which have done well elsewhere were given out, Co.-205 a Madras seedling from the Gurdaspur Farm was tried at the Hansi Agricultural Station and did exceedingly well. Its seed has also been given out. Striped Mauratious is very successful in the neighbourhood of Ferozepore town. It is an early cane, tall growing and is not much damaged by wild animals.

Barley—Is a very important crop in the Gurgaon District : varietal trials at the Hansi Agricultural Station and with zamindars in the Gurgaon District show that the Economic Botanist's selection type No. 4 gives the best results and has yielded over 44 maunds per acre. It is a very early type. Distribution of its seed will be taken up on a large scale next year.

Bajra and Jowar—Are very important crops for this circle and have now been taken in hand. It is regretted that it could not be done earlier for want of space and staff.

Other crops.—Japan rape, oats and groundnut have been introduced in the Ambala, Karnal, Ferozepore and Gurgaon Districts.

Rice.—Some new varieties of rice are being tried in the Ambala and Ferozepore Districts and at the Jallalabad Farm. A few trials will also be made to grow rice in the Nuh Tahsil of the Gurgaon District.

Seed, Seed Depôt and sale of seed.—We are now in a position to definitely recommend our wheat and cotton seeds. They have had exhaustive trials and wherever they have been tried, there followed an ever increasing demand for them but the arrangements for propagation, collection, storage and distribution of these seeds—while they take most of the time of our staff in districts much to the detriment of their real technical work—are far from satisfactory and quite inadequate. In the multiplication of our seed we have to depend on selected growers who have agreed to give us the produce of the pure seed which we supply to them. They have to carry on the cultivation according to our instructions. They do that alright, but at harvest great difficulty is experienced to secure their produce. This is generally the case with wheat growers. They quite rightly want to hold on and sell their produce whenever it suits them, and very often we lose our seed. Collection of cotton seed is not less troublesome. In spite of all our precautions and arrangements with buyers of Kappas most of our seed is lost. The cotton seed trouble would be removed to a very large extent when we get our own ginning installation ; provided of course that at the same time we get enough money to buy as much Kappas as we would need for our seed.

The multiplication of seed however could be arranged without any great difficulty, but there is little money and staff to collect very large quantities and no stores to store it. At present we depend upon seed depôts; financed by Government for the distribution of our seed, but how can a small advance meet all the requirements of seed of a circle. I was given this year only Rs. 60,000 for wheat seed which is not enough to supply the needs of one tahsil only. I think there is no justification for us to let the grower grow an inferior kind of crop when he could grow a better type if its seeds were placed within his reach, and this is beyond the powers of this Department in its present state of development.

The seed depôts have now been going for some years and it will be noticed that on an average the seed business has been profitable and has justified the financial help given in the matter. I think the time has come that some seed supply organisation should be seriously considered and efforts made to encourage private enterprise to take up this business. It must be acknowledged that Government agency alone unaided by private enterprise cannot hope to do much in any reasonable time in supplying all the requirements of this Province of good seed.

The selection of better varieties of crops and the production of a large quantity of seed of these crops is primarily the work of this Department, also to see that all seed sold to cultivators as improved seed is properly grown and is fit for distribution. The work of storage and distribution should be shared by others and prominently by the Department of Co-operative Societies. So far this has solely been done by us.

I understand that cash advances are made to the members of the Credit Societies for the purchase of seed at the sowing time. I think seed should be supplied instead and Societies should purchase pure seed at harvest, store it and advance it at sowing time. But so far the Societies have shirked any responsibility in the matter.

Unless the Societies come forward to take interest in the work of distribution, we alone cannot do much in our present stage of development and I do not think there is any idea to develop us more than a technical department and duplicate an organisation which is effectively supplied by the Department of Credit Societies.

Private enterprise in this matter of seed supply is so far absolutely unknown in this Province, unless the sweepings from the Banya's shop can be called seed, and something should be done to encourage it if a genuine seed supply organisation is to be built up.

Demonstration and sale of implements.—Rajah plough, Meston plough, S. T. Harrow and Horse-hoe are recommended as useful implements of culture. Little marvel plough is another useful little plough. It has one handle and comes between Rajah and Meston. Lyallpur Harrows and Drills are also recommended. Fodder cutter has proved very useful and is much liked in this tract where fodder famines are not uncommon. They are a great help in fodder economy, since the prices of grain are so high, and the area under fodders has gone down. The machines on the market are not quite strong enough but those are the ones that can be had. Their prices too stand in the way of their freely buying by farmers and other cattle owners.

Sardar Darshan Singh's sowing drill is now almost complete and gave very satisfactory results last rabi. With same labour it can do five times the work ordinarily done by zamindars. The seed rate too is more uniform and ensures good and even germination.

The demonstration of implements is given at almost all important fairs (cattle and religious) in this circle, but such demonstrations do little more than to introduce us to the people attending such fairs. Instructive demonstrations however are carried out in villages only. These are more successful as they are attended by zamindars interested in Agriculture, who fully discuss the objects demonstrated. More attention is also now given to concentrate such demonstrations very often in one locality so that the interest created can be followed and kept up rather than have them all over a district to excite merely a curiosity. The result of this concentration has been that there are in some villages as many as 70 ploughs in use besides Chaff Cutters and other improved implements.

The sale of implements has not been very large as the past season in this circle has been dry and hard. Moreover the high prices of implements and their spares do not allow zamindars to go in for them to a very large extent. There is further the difficulty of obtaining them as there is no agency stocking such implements for sale in this circle. I have

accordingly recommended that a Machinary Depôt be opened in the circle. It is very important that implements and their spares should be easily available if the enthusiasm of those using them is to be kept up. The important demonstrations at fairs were :—

Maghi fair, Muktsar.

Cattle fair, Ambala.

Cattle fair, Hissar.

Cattle fair, Hansi.

Cattle fair, Bhiwani.

Cattle fair, Jahazgarh.

Cattle fair, Palwal.

Pehowa (Karnal) fair.

The following implements were sold during the year :—

Rajah ploughs	...	...	...	20
Meston ploughs		...	...	145
S. T. Harrows	...	...	...	3
Cotton Hoe	...	...	...	1
Cotton Drill	...	...	..	2
Lyallpur drills	...	...	...	2
Fodder cutters	...	...	...	9
Bar Harrows	...	...	...	5
Little Marvel ploughs	...	...	...	2
		Total	...	189

Demonstration plots and demonstration of improved methods of cultivation.—There are 40 demonstration plots in this circle. All have been very successful. The results are given in the statement attached.

It has been rightly remarked that cultivator is the best demonstrator and I do not think there is any better form of propaganda work than these plots to show the superiority of our seeds and methods, as all the operations are carried out by the cultivator himself on his own lands side by side with his own methods and nothing can convince him better than such results.

Green Manuring.—Our soils are found wanting generally in organic matter. To improve them green manuring with San and Gowara was recommended in the Ferozepore District and demonstrations of ploughing in the green manure crops by furrow turning ploughs were given in many places. To convince people of the great value of this method of manuring 4 demonstration plots were also arranged at Butter, Baghapurana, Rode, Malke and Poohla. The results below speak for themselves and not unnaturally have created a great demand for similar demonstration

which with the limited staff and implements at our disposal we can only do our best to meet as far as possible :—

Serial No.	Name of place.	Produce per Acre.						Remarks.
		Zamindari plot.			Demonstration plots.			
		M.	S.	C.	M.	S.	C.	M.
1	Butter ...	14	0	0	19	0	0	plus 5 Area 1 acre.
2	Baghapurana ...	20	0	0	31	0	0	plus 11 Area 1 acre.
3	Rode ...	19	0	0	23	0	0	plus 4 Area 2 acres.
4	Malke ...	Results not available.						
5	Poohla ...	18	0	0	22	0	0	plus 4 Area 4 acres.

Detailed account of cultivation of Baghapurana green manuring demonstration plot.

Demonstration Plot. (*Area one acre. Crop Wheat*)	Rs.	A.	P.	Zamindari Plot. (*Area one acre. Crop Wheat.*)	Rs.	A.	P.	Remarks.
Cost of San (Hemp) seed 30 seers	4	0	0	Cost of 9 carts load of farm yard manure ...	9	0	0	
Sowing of seed	1	0	0	Cartage of manuring ...	4	8	0	
Ploughing in of San crop ...	5	4	0	Wages of two men for manure spreading ...	1	0	0	
Three ploughings (preparatory tillage)	6	0	0	Three ploughings (preparatory tillage) ...	6	0	0	
Cost of 24 seers seed ...	6	0	0	Cost of 24 seers of seed	6	0	0	
Five waterings	3	0	0	Five waterings	3	0	0	
Total ...	25	4	0	Total ...	29	8	0	
Outturn in maunds	31	0	0	... ...	20	0	0	
Outturn in Rupees	186	0	0	... ...	120	0	0	
Net receipt per acre in Rupees ...	160	12	0	... ...	90	8	0	
Net profit per acre from green manuring in Rupees					160	12	0	
					90	8	0	
					70	4	0	

Eradication of grasses.—Demonstration plots for the eradication of Dab and other notorious grasses were started in the Ferozepore District and some 8 villages. The area under demonstration plots except at Bazidpur, where it was only two acres, varied from 10 to 50 acres. The rabi crops on these plots gave much better results than ont heir neighbours.

Sowing in lines.—The demonstration of sowing cotton and maize in lines and interculturing was continued. The practice is not likely to spread in the Southern districts as long as labour is cheap and available for interculture. It is however steadily spreading in Ferozepore.

Agricultural Associations.—There were 4 agricultural associations in this circle. Another one at Gurgaon has been added during the year under report. These associations do very useful work in the beginning but eventually for want of interest in their working they become uninviting and serve no useful purpose and are meagrely attended. The attendance of members at the last Karnal Association meeting was only 5.

The Association at Hissar in consultation with the Deputy Commissioner who is its president has been suspended. He agreed with me that it was a useless body. The District Board at its next meeting proposes to start it a fresh for the Hansi Tahsil only.

The association at Gurgaon is too young to call for any remarks but the others are as bad as the Hissar. The members take little interest in them.

The Rohtak Association is the only one which is said to be doing well and is well attended. Its composition is better. Members are interested in agriculture and its improvements, and most of them are "Khud Kasht." Of course the District Board pays them their expenses for attending the Association meetings.

I think after some 5 years' existence of these Associations, the Department and its activities become well known in a district and need no such help in propaganda work as is expected of these bodies. If these Associations could take up some other line of work than mere propaganda they could be more useful.

There is another thing we too do not try to make these meetings quite interesting for the members. The same old story of the Rajah plough and 8-A. seed is repeated at every meeting and it loses interest. Human nature asks for novelty and we ought to bring in the scope of these Associations every thing that appertains to the welfare of a farmer.

Agricultural Shows.—A display of agricultural produce in addition to demonstration of agricultural machinery was made at Palwal, Rohtak, Ambala, Jahazgarh and Lahore.

Lahore show.—Although this show was held outsidute this circle, but as I was placed in charge of it I think I had better make a mention of it in my report.

During the visit of His Royal Highness the Prince of Wales it was decided by the Punjab Reception Committee to hold a people's popular Mela at Lahore. This was to include an agricultural exhibition also. Accordingly a display of agricultural machinery and produce was arranged. Each section was represented and was responsible for its own exhibits.

Besides the usual display of wheats and cottons and other seeds and the usual demonstration of our implements, practical demonstrations of butter making, tractor ploughing, silk worm rearing, wireless telegraphy, lantern lectures and other physical experiments formed part of the show. Even gardening was not forgotten and seedlings of fruits and decorative plants were prominently exhibited. The models of water lifts designed by Mr. Brownlie were also there and were demonstrated working, power plant having accompanied them from Lyallpur. The show was located in the most prominent part inside the fenced enclosure of the Mela ground just close to the main entrance and attracted vast crowds. Every body who came to the Mela (Grand-Stand excepted) must have had a look at our exhibition before he got into the Arena.

The Entomologist's show as usual was very interesting and attractive. The working models of M. Brownlie and the butter making demonstrations of Mr. Stewart were another great attraction and were attended by crowds both interested and inquisitive.

The demonstration of implements and tractors was also arranged in another similar very prominent space next to the Visitors' camp where some 6,000 agriculturists from districts were putting up. It was separated from the Sardars' (all leading landlords of Rawalpindi and Multan Divisions) camp by a road only and had further the proud privilege of having the Royal route passing along it.

Demonstrations were given in the mornings and evenings only but the show was open throughout the day.

By the kind courtesy of the officer in charge of the Mela, Khan Bahadur S. Lyaqat Hayat Khan of the Indian Police, and on account of his very keen and sympathetic interest in everything that concerned our section, for which our sincere thanks are tendered to him, Saturday morning was made a special day for agricultural demonstrations, all other side-shows being stopped. Agricultural Department was so prominent everywhere that it was justly remarked that the Prince's Mela was more of an Agricultural Department's show My thanks are also due to Mr. Hardie, Superintendent, Lawrence Gardens, for decorating with his plants and palms the big central circle of the Mela ground which flew the Union Jack.

Special help.—The District Boards of Ferozepore, Rohtak and Gurgaon are very helpful in our work. The Gurgaon District Board is vigorously pushing on the propaganda work in introducing the agricultural machinery by holding ploughing competitions and offering prizes at their cattle fairs. They also propose to hold ana nnual show of agricultural produce of the district at which prizes will also be offered for best exhibits. It has further taken another step in the right

direction and set an example for other district boards to be followed with advantage by purchasing Rs. 20,000 worthof improved wheat seed for their district. Seed is to be sold at cost price at sowing time. The object in view is to introduce this improved seed into their district.

Prizes were also offered for agricultural exhibits (produce of their districts) by the District Boards of Rohtâk and Ambala. The former does this simply to introduce our seed and to popularise them.

The Rohtak District Board also pays the expenses of the members attending meetings of their Agricultural Associations.

The Ferozepore District Board pays for one of our Senior Assistants for their district.

Acknowledgements.—This circle is fortunate in the present Deputy Commissioners at least; all of them take a very keen and sympathetic interest in our activities.

Mr. Ferguson, I.C.S., Deputy Commissioner, Rohtak, takes with him in camp a moving demonstration. He carries with him implements and seeds that are recommended by the Department and explains their usefulness at every stage of his tour. Even the visitors at headquarters are not allowed to go away without having a look at these seeds which are exhibited in a prominent place in his office room.

Mr. Brayne, I.C.S., Deputy Commissioner Gurgaon's interest in agriculture is well known. He is pushing on the agricultural work in his district with the ardour of an enthusiast and does not allow any occasion slip to impress upon his zamindars the urgent necessity of improving their agriculture and upon the Department the needs of his district in that line.

The great success of the Lahore Exhibition was mainly due to the keen interest taken by Khan Bahadur S. Liaqat Hayat Khan of the Indian Police (officer in charge of the Prince's Mela) in all our shows and demonstrations.

The success of the Rohtak and Jalalabad Demonstration Farms is due to the keen interest taken in them by Hony. Lt. R. B. Chaudhri Lall Chand and Sheikh Nazir Ahmad, P.C.S., Manager, Mamdot Estate, respectively. Our sincere thanks are due to all these gentlemen for their help.

Among the District Assistants Bhai Sucha Singh, Agricultural Assistant, Ferozepore, and, Chaudhri Saroop Lall, Agricultural Assistant, Rohtak, have done exceedingly well and deserve special mention. They are very tactful and popular in their districts and take a keen and intelligent interest in the work. They deserve the success that has accompanied their efforts. Bhai Arjan Singh, Agricultural Assistant, Moga too has shown an aptitude for propaganda work and has done very well.

FATEHUDDIN,

Deputy Director of Agriculture,

Punjab, II Circle, Hansi.

STATEMENT SHOWING THE PRODUCE OF DEMONSTRATION PLOTS AS COMPARED WITH ZAMINDARI PLOTS.

Serial No.	Name of District.	Name of village.	Produce per acre.						Name of crop.	Results.			Financial results.			Remarks.
			Zamindari plot.			*Demonstration plot.*										
			M.	S.	Ch.	M.	S.	Ch.		M.	S.	Ch.	Rs.	A.	P.	
1	Rohtak ...	Rurki ...	29	19	15	36	0	0	Wheat ...	* 6	20	0	* 40	12	0	
2	„ ...	Chari ...	27	34	0	31	8	0	„ ...	* 3	14	0	* 20	15	0	
3	„ ...	Bhainswal Kalan	27	8	0	28	37	12	„ ...	* 1	29	12	* 10	14	6	
4	„ ...	Rohtak ...	23	30	0	23	32	0	„ ...	* 5	2	0	* 31	9	0	
5	„ ...	Pipli Khera ...	19	8	0	20	16	0	„ ...	* 1	8	0	* 7	8	0	
6	„ ...	Daryapur ...	15	10	0	19	30	0	Gram ...	* 3	20	0	* 17	8	0	
7	„ ...	Beri ...	14	30	6	19	8	0	Wheat ...	* 4	17	10	* 27	11	3	
8	„ ...	Zafarpur ...	12	0	0	14	28	0	„ ...	* 2	28	0	* 17	0	0	
9	„ ...	Dobh ...	9	0	0	12	0	0	„ ...	* 3	0	0	* 18	12	0	
10	„ ...	Bhalant ...	Results better but not available.						Gram ...	Results better but not available.						
11	Ferozepore	Malke ...	19	0	0	21	0	0	Wheat ...	* 2	0	0	* 12	0	0	
12	„ ...	Zira ...	12	0	0	15	0	0	„ ...	* 3	0	0	* 18	0	0	
13	„ ...	Baring Khera..	6	0	0	8	0	0	Cotton ...	* 2	0	0	* 24	0	0	
14	„ ...	Budh Singhwala	5	37	0	7	10	0	„ ...	* 1	13	0	* 15	14	6	
15	„ ...	Bagapurana ...	5	9	0	8	3	0	„ ...	* 2	32	0	* 21	9	6	
16	„ ...	Chak Ganda Singh wala.	5	0	0	6	0	0	„ ...	* 1	0	0	* 12	0	0	
17	Hissar ...	Jamanri ...	23	20	0	25	0	0	Wheat ...	* 1	20	0	* 9	6	0	
18	„ ...	Sisai ...	22	9	0	23	11	0	„ ...	* 1	2	0	* 6	9	0	
19	„ ...	Bhatla ...	9	30	0	12	10	0	„ ...	* 2	20	0	* 15	10	0	
20	„ ...	Kunbha ...	Results better but not available.						„ ...	Results better but not available.						

* Denotes increase in comparison.

REPORT

ON THE OPERATIONS OF THE

DEPARTMENT OF AGRICULTURE, PUNJAB.

For the year ending 30th June 1923.

PART I.

Lahore:
Printed by the Superintendent, Government Printing, Punjab.
1924.

Revised List of Agents for the sale of Punjab Government Publications.

In the United Kingdom.

Constable & Co., 10, Orange Street, Leicester Square, London, W. C.

Kegan Paul, Trench, Trübner & Co., Limited, 68-74, Carter Lane, E. C., and 39, New Oxford Street, London, W. C.

Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.

T. Fisher Unwin, Limited, No. 1, Adelphi Terrace, London, W. C.

P. S. King & Son, 2 & 4, Great Smith Street, Westminster, London, S. W.

H. S. King & Co., 65, Cornhill, and 9, Pall Mall, London.

Grindlay & Co., 54, Parliament Street, London, S. W.

W. Thacker & Co., 2, Creed Lane, London, E. C.

Luzac & Co., 46, Great Russell Street, London, W. C.

B. H. Blackwell, 50 and 51, Broad Street, Oxford.

Deighton Bell & Co., Limited, Cambridge.

Oliver & Boyd, Tweeddale Court, Edinburgh.

E. Ponsonby, Limited, 116, Grafton Street, Dublin.

Messrs. Wheldon & Wesley, Limited, 2, 3 & 4, Arthur Street, New Oxford Street, London, W. C. 2.

Messrs. East & West, Limited, 3, Victoria Street, London, S. W. I.

On the Continent.

Ernest Leroux, 28, Rue Bonaparte, Paris, France.

Martinus Nijhoff, The Hague, Holland

Otto Harrassowitz, Leipzig.

Friedlander & Sohn, Perlin.

In India.

The Manager, Imperial Book Depôt, Delhi.

Gulab Singh & Sons, Mufid-i-'Am Press, Lahore.

Manager, Punjab Law Book Depôt, Anarkali Bazar, Lahore.

Rama Krishna & Sons, Book-sellers and News Agents, Anarkali Street, Lahore.

Honorary Secretary, Punjab Religious Book Society, Anarkali, Lahore.

M. Abdul Aziz, Manager, The *Vakil* and Roze Bazar Electric Press, Amritsar.

L. Labhu Ram, Book-seller, Ludhiana.

N. B. Mathur, Superintendent and Proprietor, Nazir Kanun Hind Press, Allahabad.

D. B. Taraporevala, Sons & Co., Bombay.

Thacker, Spink & Co., Calcutta and Simla.

Newman & Co., Calcutta.

R. Cambray & Co., Calcutta.

Thacker & Co., Bombay.

Higginbothams, Limited, Madras.

T. Fisher Unwin, Calcutta.

V. Kalyanaram Iyer & Co., 189, Esplanade Row, Madras.

G. A. Natesan & Co., Madras.

Superintendent, American Baptist Mission Press, Rangoon.

The Manager, "Hitavada," Nagpur, Central Provinces.

TABLE OF CONTENTS.

Para.	Contents.	Page.
	SECTION I.	
1	Preliminary	1
2	Staff	*ib.*
3	The Punjab Agricultural College, Lyallpur, and classes at Gurdaspur Farm	2
	SECTION II.	
	Farm and District Work—	
4	Cottons	6
5	Comparison of 4-F and 285-F American types of cottons	7
6	Causes of the poor quality of cottons in 1919 and 1921	8
7	Adulteration of cottons	9
8	Cotton auctions	10
9	Cotton prices	11
10	Wheat	*ib.*
11	Trials of 8-A and Punjab 11	12
12	Milling tests	14
13	Ear-cockle disease in wheat	*ib.*
14	Sugarcane	*ib.*
15	Red rot disease in sugarcane	15
16	Seed depôts	*ib.*
17	Implements	16
18	Agricultural Associations	*ib.*
19	Demonstrations and Exhibitions	*ib.*
20	Seed and Demonstration Farms	17
	SECTION III.	
	Economic Botany—	
21	Improved crops	18
22	Crop testing	19
	Agricultural Chemistry—	
23	Analyses	20
24	Bara Reclamation	21
25	Sullage Experiments	*ib.*
26	Green manuring	*ib.*
27	Soil fertility	22
28	Food values	*ib.*
29	Entomology—	*ib.*
30	Sericulture	23

Para.	Contents.	Page.
	SECTION III—*concluded*	
31	Agricultural Engineering	24
32	Well boring in ordinary wells	*ib.*
33	Tube wells	25
34	Miscellaneous	*ib.*
	SECTION IV.	
35	The Lyallpur Wheat Elevator	25
36	Concluding observations...	28
	ANNEXURES.	
No.		
I	Statement showing the results of the Agricultural College passing out examination from the year 1914 onwards	31
II	Statement showing disposal of silkworm seed imported during the last 6 years	*ib.*
III	Profit and Loss Account of wheat seed depôts in the Punjab for the year ending 31st March 1923	32
IV	Profit and Loss Account of cotton seed depôts in the Punjab for the year ending 31st March 1923	*ib.*
V	Statement showing sowings of wheat (Punjab-11 and 8-A) in Canal Colonies in the Punjab ...	33
VI	Statement showing sowings of cotton in canal-irrigated areas in the Punjab	34—35
VII	Statement of cotton auctions held by the Agricultural Department during the year 1922-23 ...	36—37
VIII	Statement showing the sale in the Punjab of improved Agricultural Implements during the year ending June 30th, 1923.	38
IX	Statement showing the purchase of wheat seed in seed depôts of the Punjab in 1923 ...	39—40
X	Statement showing the purchase of cotton seed in seed depôts in the Punjab in 1923 ...	41
XI	Statement showing the income and expenditure of various Demonstration Farms in the Punjab, during 1922-23	42
	APPENDICES.	
No.		
I	Report of the Principal, Punjab Agricultural College	i—vi
II	Report of the Economic Botanist to Government, Punjab	vii—xvi

Para.	Contents.	Page.
	APPENDICES—CONCLUDED.	
III	Report of the Agricultural Chemist to Government, Punjab	xvii-xxiv
IV	Report of the Entomologist to Government, Punjab	xxv-xxxi
V	Report of the Agricultural Engineer to Government, Punjab	xxxii—l
VI	Report of the Professor of Agriculture, Lyallpur, on District Work	li—lx
VII	Report of the Deputy Director of Agriculture, 1st Circle, Gurdaspur, on District Work ...	lxi—xci
VIII	Report of the Deputy Director of Agriculture, 2nd Circle, Hansi, on District Work ...	xcii—cxl

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY.

Proceedings of the Punjab Government (Ministry of Agriculture), No. 491—50-L-3400, dated 26th February 1924.

READ—

Letter No. 572, dated 23rd January 1924, from the Director of Agriculture, Punjab, forwarding the Annual Report on the operations of the Department of Agriculture in the Punjab for the year ending 30th June 1923.

REMARKS.—The Report of the Principal of the Punjab Agricultural College, Lyallpur, discloses a useful, if uneventful, year's work. The results of the various examinations were satisfactory. The health of the students was good, and there was a welcome absence of political activities, which are out of place in an Agricultural College. The full number of candidates (53) was admitted and the quality was up to standard, 48 or rather more than the usual proportion being agriculturists. There was, however, a marked decrease in the number of applicants for admission, which was probably largely fortuitous, and need not be regarded as evidence of a permanent decline in the popular estimation of an agricultural training. A plentiful supply of trained agriculturists is indeed a vital need for an agricultural province like the Punjab, but will not be forthcoming without assured and sufficient prospects of employment. Government will do all they can to help by recruiting agricultural graduates for Government Departments as suggested by the Director ; but this field is limited and must be supplemented by a general demand on the part of the land-owning classes for progressive methods and up-to-date results. The need of the hour is for more private citizens like Sir Ganga Ram who has given a practical example of what successful agriculture can do, and whose lecture to the College students on " Agriculture as a Profession " made a great impression.

2. The Lyallpur College is also the centre of the Department's two other main activities, research and demonstration. Here the work of the laboratory and the field is correlated by experts working in close touch with the Deputy Directors in their outlying circles. The reports of all these officers, which are summed up in an interesting review by the Director, display the multifarious character of the work done and its far-reaching effects on the agriculture of the Province. The Director's estimate that the various improvements introduced by the Department, are worth crores of rupees annually to the Province is probably no exaggeration.

But a whole army of assistants and workers is needed to carry the message of the department to the cultivator as the latter being illiterate can only be made to understand the good results of the labours of our hardworked Research experts if he is given a demonstration of the same within his easy reach. It is the want of proper staff to do this work that has made an eminent authority on Revenue matters say that "we have given education in agriculture to some no doubt, but so far we have not been able to give education to the agriculturist". Government are fully alive to all these needs of the people and have under contemplation the preparation of a five years' programme of work which, if sanctioned by the Legislature, will make it possible for agriculture and agricultural education to proceed on scientific lines. Agriculture is a scientific department and cannot afford to be well fed this year and to be starved next. The progress should be steady and well guaranteed. Given more money, the department are bound to give startling results.

3. In the introduction of improved crop varieties alone, the work of the Economic Botanist Section has been of incalculable value. Among the most important of these varieties is American cotton with its staple double the length of the indigenous variety. The success of this cotton during the year under report is therefore an event of particular interest as there was at one time a fear that the disastrous seasons of 1919, 1920 and 1921 had ruined it permanently. Success has been sealed by the discovery of the reason for failure, namely, insufficient watering during the flowering and fruiting seasons, and it appears to be definitely established that given proper attention, Punjab American cotton has come to stay. This being so, it is a thousand pities that the vagaries of the market and a short-sighted desire for immediate gain has led to the custom of adulterating the American with the short-stapled Desi cotton. The problem of how to prevent this adulteration is receiving earnest attention and legislation to enable the compulsory licensing of gins and presses is contemplated as an immediate measure. There are, however, those who think that legislation cannot get to the root of the evil, and Government trust that Mr. Milne's proposal that cottons should be sold on a certificate of quality will be explored to the utmost both by the Indian Central Cotton Committee and by the Cotton Research Expert, whom the Committee have since the close of the year under report, decided to depute to the Punjab for five years' work.

4. Among other improved crop varieties introduced by the Department are the two wheats known as 8-A and Punjab-

11. The latter was first in the field, but 8-A is destined to supplant it, as after many years' experiments it has this year been definitely established that 8-A is a better yielder or both grain and straw on average quality land either irrigated or unirrigated. In view of the fact pointed out by the Director that at a moderate estimate it yields 1½ to 2 maunds of wheat more per acre than Punjab-11, the value of this discovery to a province growing 8 to 10 million acres of wheat, can hardly be exaggerated.

But so far unirrigated areas and crops grown on these areas have not hitherto received the attention they deserve as more than 50 per cent. of the area under cultivation in the Province is *barani* and deserves increased attention. Similarly pulses and vegetable also need improvement both in quality and quantity. All this is due to the lack of proper agency which can come into being if money were forthcoming. It has not been possible for Government on account of financial disabilities even to prepare these schemes, but as better times are coming and the members of the Punjab Council are evincing greater interest in agricultural problems now than before it is hoped that a Dry Farming Institute and other necessary agencies will come into being in the near future.

5. The researches of the Economic Botanist are not confined to the major crops of cotton and wheat. Improved varieties of sugarcane, gram, barley and oats are also under trial. Scotch potatoes in the Simla hills continued to give much larger yields than the local varieties. The date crop in the south-west was a particularly heavy one and of excellent quality. This industry appears to offer a promising opportunity for enterprise and capital.

Mr. Milne's review contains some interesting remarks on the testing out of crop varieties on duplicate plots. The impossibility of obtaining exactly similar conditions of growth on all plots necessitates an expert diagnosis of results on a small number of plots rather than a mathematical comparison of the outturns of a large number.

6. The Agricultural Chemist's department continued its series of researches into the chemical composition of soils and the effects of different manures and chemicals on soils and crops. The problem of the reclamation of the *kara* soil of the Lower Bari Doab Canal Colony has not yet yielded its secret. The question of the continuation of this costly experiment has received attention and after local inspection by the Minister and the Financial Commissioner (Development) it has been

decided that the experiment should continue, but that the expenditure should be limited to Rs. 30,000 per annum, including supervision. Government will carefully watch results.

For some time past need had been felt for an extension to the Chemistry Block of the Lyallpur College. The Legislative Council is being approached for a grant of Rs. 1,50,000 and it is hoped that the long overdue work in manures will be seriously taken in hand. In some of the older tracts there is so much intensive farming going on that artificial manures are becoming almost a necessity and a great demand will be created for them during the next few years.

7. The work of the Entomological section was again badly handicapped by insufficiency of staff and lack of an insectory and other equipment, but was prosecuted with the usual vigour and enthusiasm. Seven original papers were published and numerous lectures and exhibitions given. Valuable assistance was rendered against depredations of crop pests, to the extent of the staff available. Sericulture is also an important branch of the work which the department are prevented from developing by lack of staff. Somewhat less silk seed was distributed than in the previous year; but the output of cocoons was as high as before and the quality was good.

8. Work of considerable value was carried out at the Lyallpur Workshop under the superintendence of Mr. Miller Brownlie, Agricultural Engineer, though a number of machines designed for electric drive were kept idle owing to electric power not yet being available. Among other improvements, Mr. Miller Brownlie's cheap power-boring plant was further perfected and a hand-boring plant was also devised. The well-boring department is suffering from old and worn-out plant. Sanction to purchase new plant was given in January 1923, but in March 1923 the Legislative Council refused to grant more than Rs. 30,000 out of the Rs, 60,000 required. Funds were also refused for a Sub-Divisional Officer and other establishment. The new overhead charge does not appear to have been very successful: but Government will be prepared to consider any proposals that may be submitted for an alteration of the new rules in the light of experience. The development of tube wells is still restricted by the high price of plant and the scheme for irrigating a larger area of Government waste land near Jhang when worked out in detail was unfortunately found to be too costly to pay.

9. Interesting reports on district work are furnished by the officers in charge of the Lyallpur, Gurdaspur and Hansi

circles. The tireless propaganda of the department in advocating improved seeds, methods and implements, by exhibitions at fairs, by demonstrations on farmers' own land and by intensive work in selected villages, deserves every commendation and was attended by gratifying success. It is unfortunate that lack of funds had prevented the formation of a Multan circle : but work has been extended from the Lyallpur circle into the Multan area, and officials of the department have been posted at Muzaffargarh and Dera Ghazi Khan for the first time. It is hoped, however, to find money for expansion in the next financial year, and the Council are being asked for funds for six more Agricultural Assistants and 12 more Muqaddams.

10. The semi-commercial concerns run by the Department met with varying success as paying propositions. The depôts at Lyallpur and Gurdaspur for sale of agricultural machinery are reported to have had a successful year : but while there was a profit of Rs. 12,675 over the Department's purchase and sale of cotton seed, the wheat seed transactions showed a loss of Rs. 35,852 due to high prices at time of purchase and a slump at sowing time. The Director is, however, right in pointing out that merely commercial considerations cannot prevail, and that against this deficit must be off-set the great advantages conferred on farmers by the supply of good seed of pure types. Similarly with the Seed and Demonstration Farms controlled by the Department, of which 11 were run at a profit and 3 at a loss. Inferior varieties of crops must be shown alongside the good ones and, as was pointed out in last year's review, profits cannot be secure unless the farm area is big enough. It is only when the loss to the department is out of all comparison to the advantage to the public, that Government cannot afford to continue the concern, and an instance is afforded by the Lyallpur Wheat Elevator which has been a disappointment owing mainly to the want of a corresponding Elevator at Karachi. Government will probably now be reluctantly compelled to give up this embarrassing experiment.

11. There were no additions to the establishment during the year, though, as remarked before, it is hoped to obtain funds for some more agricultural assistants and muqaddams with the next financial year. There were a good many changes of Director. Mr. S. M. Jacob, I.C.S., continued to officiate till the 2nd October 1922. Mr. D. Milne, I.A.S., then took over charge in addition to his own duties as Professor of Botany, Economic, Botanist and Principal of the Agricultural College till the 19th December 1922, when Mr. C. A. H. Townsend, C.I.E., I.C.S., the permanent Director, returned from leave. Mr. Townsend held

charge till May 1923, when he became Commissioner of the Jullundur Division and Mr. D. Milne, I.A.S., again took over the officiating charge which he still holds. Government are indebted to all these officers for their administration of the Department and to the Department itself for another year of endeavour and success.

ORDER:—Ordered that a copy of these remarks be forwarded to the Director of Agriculture, Punjab, for information, that they be published in the *Punjab Gazette* and submitted with copies of the report to the Government of India, in the Department of Education, Health and Lands.

By order of the Punjab Government
(Ministry of Agriculture),

E. R. ABBOTT,

LAL CHAND,
Minister for Agriculture.

Financial Commissioner and Secretary to Government, Punjab (Development Department).

25 DA—890—22-8-24—SGPP Lahore.

No. 572.

FROM

D. MILNE, ESQ., Sc. (Agri.), I.A.S.,
Offg. Director of Agriculture, Punjab,

To

THE FINANCIAL COMMISSIONER AND
SECRETARY TO GOVERNMENT, PUNJAB,
DEVELOPMENT DEPARTMENT, LAHORE.

Dated Lahore, the 23rd January 1924.

SUBJECT :—*Report on the operations of the Department of Agriculture, Punjab, for the year ending 30th June 1923.*

SIR,

I HAVE the honour to submit for favour of review by Government a clean proof of the report on the operations of the Department of Agriculture, Punjab, for the year ending 30th June 19.3, complete with appendices. I much regret the delay in its submission which was due to my being ill for about 2 months and subsequent weakness.

I have the honour to be,
SIR,
Your most obedient servant,
D. MILNE,
Offg. Director of Agriculture, Punjab.

25 DA—390—22-3-23—SGPP Lahore.

Report on the Department of Agriculture, Punjab, for the year 1922-23.

Section I.

Preliminary.

In submitting my report of the Agricultural Department for the year ending 30th June 1923, I wish to say that I have only touched very briefly on a few points mentioned in the reports of the various experts,—(*vide* Appendices I—VIII) and that these reports must be read in order to get a proper conception of the large amount of work which has been done in the various sections.

Staff.

2. Mr. Jacob, officiated as Director of Agriculture up to 2nd October 1922. I took over from him, and continued to officiate as Director in addition to my duties as Professor of Botany, Economic Botanist and Principal of the Punjab Agricultural College, Lyallpur. Mr. Townsend, the permanent Director, on return from leave on the 19th December took over charge of the Department, but in May 1923 he was appointed Officiating Commissioner of the Jullundur Division and I was again appointed officiating Director of Agriculture on the 15th of that month. Mr. Brownlie, Agricultural Engineer to Government, Punjab, was then appointed officiating Principal of the Agricultural College in addition to his duties, and Agha Yusaf Ali Khan, Assistant to the Economic Botanist, Punjab, and Lala Chuni Lal, M. Sc., Assistant Professor of Botany, were appointed to officiate as Economic Botanist and Professor, of Botany, respectively.

S. Darshan Singh, I. A. S., Deputy Director of Agriculture, remained in charge of the Second Circle during the year under report except for a period of about ten weeks, from 1st July to 5th September, when Khan Sahib Maulvi Fateh-ud-Din, I. A. S., officiated for him.

M. Sultan Ali, I. A. S., Deputy Director of Agriculture, First Circle and Mr. Stewart, Professor of Agriculture, held charge of their respective Circles throughout the year. Mr. Johnston, I.A.S., Deputy Director of Agriculture, Lyallpur, proceeded on leave in the end of May and Chaudhri Muhammad Abdulla, I. A. S., Deputy Director of Agriculture, officiated for him in addition to his own duties.

The services of Sardar Sahib Kharak Singh, Associate professor of Agriculture, were placed temporarily at the disposal of the Chief Engineer, Public Works Department, Irrigation Branch, with effect from the forenoon of 23rd May 1923, in connection with the abstraction of results from crop irrigation observations recorded by the Irrigation Department. He resumed charge of his duties at Lyallpur on 19th July 1923.

Khan Sahib Maulvi Fateh-ud-Din, I. A. S., is working as Personal Assistant to the Director of Agriculture.

The services of Mr. O. T. Faulkner, Deputy Director of Agriculture, Lyallpur, were transferred permanently to the service of the Nigerian Government with effect from June 15th, 1921.

The post of Second Economic Botanist was converted into that of Associate Professor of Botany, and was filled by Rai Sahib Lala Jai Chand, Assistant Professor of Botany, on his promotion to the Indian Agricultural Service with effect from 27th August 1923.

The sanctioned posts of Second Agricultural Chemist, Bacteriologist, the Soil Physicist and the second Agricultural Engineer are still vacant.

Among Provincial Service Officers Bh. Gurdial Singh, Extra Assistant Director of Agriculture, Kahuta, was transferred to Sargodha and Bh. Arjan Singh, Agricultural Assistant, was appointed in his place in December 1922. M. Charan Singh, Extra Assistant Director of Agriculture, Montgomery, went on short leave for three months on 9th July 1923 afternoon. M. Muhammad Hasan Khan, Agricultural Assistant, has officiated as Assistant to the Economic Botanist, *vice* Agha Yusaf Ali Khan from 15th May 1922. Bhai Kartar Singh, Agricultural Assistant, was appointed second Assistant Professor of Agriculture on 31st October 1922 and Chaudhri Ali Muhammad, Agricultural Assistant, was appointed to officiate as Assistant Professor of Botany, *vice* Lala Jai Chand who proceeded to England on long leave in August 1922.

3. The Principal's report will be found in Appendix

The Punjab Agricultural College, Lyallpur, and classes at Gurdaspur Farm.

1, pages i—vi.

Statement showing number of applications for admission to the Agricultural College, and numbers admitted during the past 7 years.

Year.	Applications.		Total.	Admissions.		Total.
	Agricul-turists.	Non-Agri-culturists.		Agricul-turists.	Non-Agri-culturists.	
1917	78	124	202	23	16	39
1918	100	125	225	37	17	54
1919	173	92	265	47	9	56
1920	202	66	268	50	4	54
1921	151	77	228	45	9	54
1922	210	90	300	43	10	53
1923	151	29	180	48	5	53

It will be seen from the above statement that in the year under report out of about 180 applications, fifty-three candidates were admitted, and of those 48 were agriculturists. The type of candidate admitted was good but the number of applications received falls much below that of previous years. A probable reason for this is that the results of the Matriculation Examination were announced so late that they gave no time for the boys to see these, before deciding as to what would be the best career for them to take up, but the fact that the graduates are now finding difficulty in getting employment in Government Service is also a large factor. The education of these men is costly to Government; agriculture is the basic industry of the Province and there is great scope for its development, therefore it seems to me very important that all agricultural knowledge should be used to the fullest extent. As a step towards this, I would urge that graduates be given preference in the filling of Government posts involving a knowledge of agriculture. At present the best brains among the agricultural classes are being diverted to professions more lucrative than agriculture, and I think every endeavour should be made to induce men of ability to take an agricultural education. A move in this direction seems to me an urgent necessity.

The University Degree Examination for the B.Sc. (Agr.) was held in May as usual. Out of the twenty-four

candidates who appeared, eighteen were declared successful and of the six failures, two students were placed under the compartment rule, *i.e.*, have to re-appear in one subject only. The result is 75 per cent. passes and is very satisfactory.

In the First Examination in Agriculture held at the end of the Second Year Course, fourteen passed out of the twenty-seven candidates who appeared; four came under the compartment rule.

Twelve regular students and one casual student attended the two years' Leaving Certificate Course. Only one of these failed to pass the final examination.

Twenty-four students took the six months' vernacular course in Agriculture. All were declared successful in the final examination. Seventeen of these students were sons of Punjab farmers. This is a very valuable course for spreading agricultural education among the less educated people.

Twelve Senior Vernacular Certificated teachers took the "Teachers'" course which qualifies them to teach agriculture in Vernacular Middle Schools. All were successful in the final examination. This course is of one year's duration. The agricultural education given in rural Vernacular Middle Schools is of very great importance to the Province, as it reaches masses of young people, most of whom never attain the matriculation standard. The result must be a great awakening of the minds of the people to the possibilities of improving agriculture, the creation of a thirst for further agricultural knowledge and a desire to adopt improvements. Recently the Director of Public Instruction made changes in the agricultural courses given at these schools which I feel will greatly increase their utility and popularity.

The Rural Economy course of one month's duration commenced on 20th February and was attended by 3 Assistant Commissioners, 5 Extra Assistant Commissioners, 8 Canal Zilladars and 4 Inspectors of the Co-operative Department. This course is intended to give an insight to the work done at Lyallpur and to enable officers to guide zemindars to the correct source of information with regard to any difficulties they may be in. Such officers are of great help to the officers of the Agricultural Department in their work in the districts.

The improved course in Agricultural Economics has been started. This, in my opinion, is a great step in advance. At present one frequently hears most amazing opinions regarding what is, and what is *not*, in the best interests of farmers,

especially with regard to trade with foreign countries and even with neighbouring provinces.

The evening lectures on agriculture and allied subjects delivered at the College by distinguished visitors were very instructive. They broaden the outlook of visitors, staff and students.

As already mentioned an Associate Professor of Botany has been appointed since the Principal wrote his report. This will help greatly with the teaching work in that section.

We have not been able to make much progress with the extension of hostel accommodation and of the Chemical block. Revised estimates for the construction of these are being prepared and it is hoped funds will be provided in 1925-26. The construction of a much needed dispensary in the College estate will, I hope, be taken in hand in the next financial year.

The construction of three bungalows for Indian Agricultural Service Officers and three for Punjab Agricultural Service Officers, who in the interests of Government work should reside on the College estate, was administratively approved in 1920 and 1921, respectively, but the work could not be taken in hand owing to want of funds. The want of these houses is causing considerable inconvenience and loss. For example, the introduction of the tutorial system which the University Inspection Committee has been pressing for, during the past three years, cannot be introduced properly until we get these quarters.

The present water supply for the College laboratories and for the domestic requirements of the estate are so seriously inadequate as to be a great danger to health. A tube well for increased water supply was sunk four years ago but the completion of the scheme awaits electric power. That power was expected to be got from an electric installation then on foot for the Lyallpur City. This, however, has not matured, and it seems essential that an electric installation for the College to provide power for this and other improtant works should be put in with as little delay as possible. The cost will probably be about Rs. 1,00,000.

I am glad to be able to note that there has been no political unrest in the College during the year and that there has been considerable progress in its working. Cordial thanks are due to the staff for their zeal and loyal support in achieving these results.

At Gurdaspur Farm 10 students passed out of the Vernacular classes; and the Soldiers' class was started on May 1st, 1923, with 8 students.

Section II.
Farm and District Work.

4. *Cottons.*—In most districts, the weather was dry in August and rain fell in September. Where the fields were not well irrigated the drought and hot winds caused flowers to fall from the plants. As August and early September is the main flowering season of Desi cottons, while the main flowering season of Americans begins at least two weeks later than that of Desis and extends through September, the Desis were hardest hit. The season on the whole, however, was not a bad one for cottons. The total area of cotton grown in the Punjab excluding Native States was 1,273,051 acres in 1922, 382,851 acres being under Americans. From Annexure No. VI, pages 34-35, it will be seen that the area of American cotton grown in the canal colonies was 365,596 acres.

On fair lands with fair cultivation the American cotton gave at least as great outturns of *kapas* per acre as Desis did and 4-F American *kapas* got a premium of Rs. 5 to Rs. 8 or more per maund over the Desis—therefore growers got at least a crore of rupees more than they would have got without the Americans. In the Hansi Circle, the *Desi* cottons grown from farm selected seeds also got a premium of about Re. 1-8-0 to Rs. 2-6-0 over the unselected Desi cottons there. The following statement shows the amounts of pure seeds purchased by the Department for resale to farmers wishing to grow pure types of cottons in 1923 :—

Statement showing the quantity of cotton seed purchased by Agricultural Department for resale to farmers wishing to grow pure types of cotton in 1923.

Name of Circle.	4-F.	285-F.	G. Iudicum Var Mollisoni.	G. Neglectum Var Rosea Bhatia cotton.	G. Sanguinium.
	Mds.	Mds.	Mds.	Mds.	Mds.
Gurdaspur ...	5,202	*Nil*	*Nil*	*Nil*	84
Hansi ...	*Nil*	*Nil*	*Nil*	3,009	*Nil*
Lyallpur ...	6,535	1,028	1,465	*Nil*	*Nil*

The demands for the seeds were keen especially for American cottons and the area under Americans will be increased greatly in the coming year.

5. *Comparison of 4-F and 285-F American types of cottons.*—The Deputy Director of Agriculture, Gurdaspur, says that the yields of 285-F., at Sargodha and Chillianwala farms and with some zemindars were lower than 4-F., but also states that experience had shown that the lines of 285-F were sown too far apart for this variety.

The Deputy Director of Agriculture, Hansi, reports that the yields of 4-F., and 285-F. were very much the same, *i.e.*, from 12 to 15 maunds per acre; 285-F., however getting a premium over 4-F.

The Professor of Agriculture, Lyallpur, says that in the Lower Bari Doab Canal Colony, 285-F., cotton was generally more favoured on the Lahore side of Montgomery, while towards its Multan side, 4-F. was considered the better. He further says that those of the growers who had 285-F. on a large scale were able to get a premium of about Rs. 2 per maund of *kapas* over 4-F., but in places where the quantity offered for sale was small, no premium was given, although the buyers acknowledged that the lint was of superior quality.

This 285-F. cotton has been grown in the Botanical Section since about 1912, and valuations of its lint by spinners for many years leave no doubt that the lint is far superior to that of 4-F. A measure of this is got from the fact that while 4-F. spins 20s to 25s, 285-F. spins 40s to 50s. From results of the severe tests which it has been put to on the Botanical farm, there is no doubt that it is earlier, more drought resistant, and a higher yielder than 4-F. Its greater earliness and drought resistance have been clearly shown by growing it and 4-F. year after year in alternative lines on the same plot. The lower yields of 285-F. than 4-F. got by some farmers are mostly associated with a thinner stand of 285-F. in the fields. This happens in the case of men not well acquainted with the variety. The seeds of 285-F. are much bigger and heavier than those of 4-F., there being 60,000 seeds in 10 lbs (a common seed rate per acre) of 4-F., while there are only 54,000 in 10 lbs of 285-F. Also a full stand of well grown plants of 4-F. on average land is about 8,000 plants per acre, while a similar stand of 285-F. has a little over 12,000 plants per acre, *i.e.*, it takes

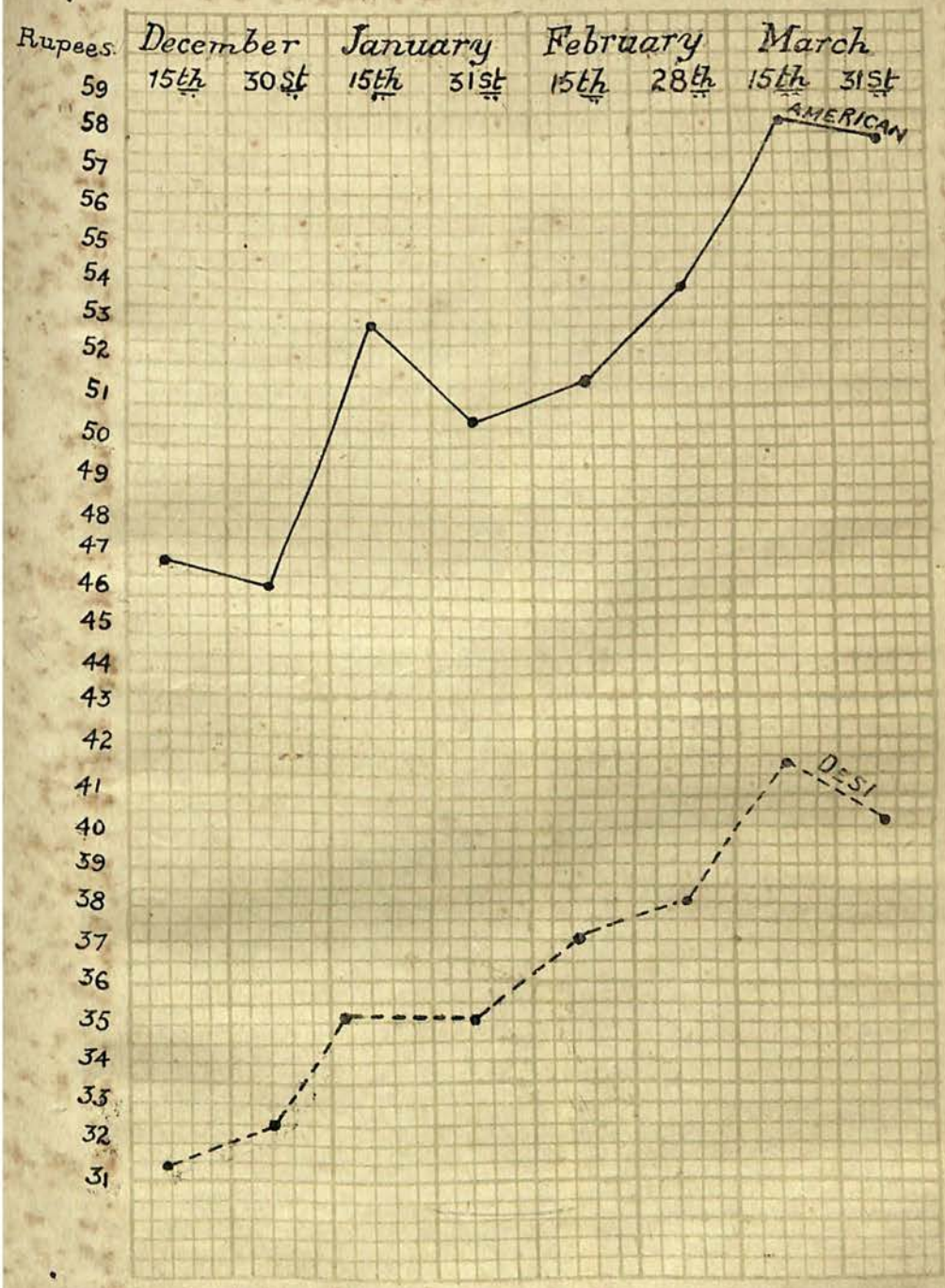
3 well grown plants of 285-F. to occupy the space required by 2 plants of well grown 4-F. Again the seeds of 285-F. are covered with a fuzz, while those of 4-F. are almost bare of fuzz, and 285-F. seeds must be well soaked before sowing in order to ensure good germination. The result of all this is that, as stated above, those who are not well acquainted with 285-F. get a much thinner stand of it than of 4-F., and consequently get a smaller outturn: see also Economic Botainst's report in Appendix 11, pages vii—xvi. Farmers who know how to grow it are making large profits out of the difference in cash returns per acre between it and 4-F., and I understand that private firms are stocking seeds of it, and getting premiums for these from farmers who have discovered its merits.

In certain soils and conditions, it is more profitable to grow Desi cottons than Americans, and in these cases, there is a keen demand for seeds of selections of Desi cottons. About 4,500 maunds of such seeds were sold to growers in the the year under report. The Hansi Circle which chiefly grows Desi cottons sold about 3,000 maunds of these seeds—practically all of the Roseum type selected at Hansi. The Deputy Director of Agriculture reports that this variety now has the confidence of the growers; that the demand for seeds far exceeds the supply, and that the above amount of seeds was the limit which the staff available were able to deal with. He thinks that between 25 per cent. and 30 per cent. of Hissar District is under this variety.

6. *Causes of the poor quality of cottons in* 1919 *and* 1921.—The most important event of the cotton season under report was the fact that the lint of the American varieties was again of as good a quality as it was about 1918. The 4-F. Amercian variety was officially given out in 1913, and up to 1919 has given to farmers higher profits than the Desis every year where it was sown on suitable soils and given proper treatment, while in years of boll worm, untimely rains, hails, etc., the difference in favour of 4-F. was greatly accentuated.

It will be remembered that in 1919, the American lint was trash on large areas; that in 1920 the lint from a smaller proportion of the crop was trash; and that in 1921, the crop of lint was again as bad as in 1919. This led many people to believe that these cottons had cross fertilized and had permanently deteriorated. The good quality of lint got from

Chart showing prices of Desi and American Cotton lint at Lyallpur.



this year's crop of plants reared from seeds of these cottons however has shown that that interpretation of the case is untenable. The correct interpretation of the cause of the poor American fibre was given in the Economic Botanist's published reports on "The causes of the cotton troubles in 1919 and 1921." Put very briefly, the cause was insufficient water for the needs of the plants during the flowering and fruiting seasons. This again was due partly to climatic conditions but greatly to high prices of wheat and toria which induced farmers to prepare a larger area of land for these crops in September, October and early November than previously, thus leaving a diminished supply of irrigation water for American cottons during the time they were flowering and developing their fibre. The trouble was of course most felt in the drier parts of the Province and Desi cottons being more drought resistant than Americans were less harmed. Desis were also very seriously affected however.

During the investigations into the case, it was observed that even in the worst affected areas, there were plants yielding good American fibre where the crop had got plenty of water during the flowering and fruiting time, and were sheltered from desiccating winds by wind breaks. It is a simple matter to provide wind breaks of Arhar (Cajanus indicus), or other suitable crops in the cotton fields and the provision of wind breaks is absolutely essential. A point to be noted is that good American lint can be grown in the Punjab in any year provided the crop receives proper attention. This is a most important fact.

7. *Adulteration of cottons.*—Unfortunately the adulteration of American cotton with Desis has risen to such a pitch in the year under report, that the reputation of Punjab American cottons in the world's markets must have been seriously damaged. The cause of the startling increase in this practice was the great rise in price of cottons during the cotton selling season, and the difference in price between Desis and Americans. A graph showing the prices of Desi and American lints at Lyallpur during that season is shown opposite.

The result was that those people who delivered American cotton sometime after they had sold it, seeing the rise in prices that had taken place in the interval, mixed Desi cottons with the American in order to recover for themselves as much as possible of the value of this rise. The buyers did not

make much fuss, provided they could still make a good profit out of the deal, but spinners got a mass of inferior cotton under the name of Punjab American.

The core of the trouble is that no accurate test is made of the economic value of cottons, until they reach the spinning mill, and therefore *cottons are sold largely on reputation.* Consequently spinners in self-defence must give relatively much lower price for future consignments than pure Punjab American cotton is worth. This loss must finally come out of the farmers' pockets, and if the practice of mixing is persisted in, it may go far to wreck American cotton growing in the Punjab. My proposal for overcoming the difficulty is to sell cottons on a certificate of quality, as many commodities now are. All the information wanted can be got from ordinary spinning mill machinery, and simple laboratory tests, but opposition is naturally to be expected for several reasons. I hope however to get a few consignments sold on this basis before long, and if once the system gets a start, it will progress rapidly even without legislation, as spinners will then have a guarantee of the quality of cottons *before* instead of *after* they buy them and competition will keep the prices up to a margin of reasonable profits for dealers. I understood that the Central Cotton Committee had recently got testing machines which would make testing even more simple than above indicated, but apparently this stage has not yet been reached. The Committee have however promised to put their Technologist on to working out details of my system as soon as he joins his appointment, but the Committee considers that it will take many years to introduce the system and strongly advocates licensing of gins as an immediate measure. The Committee has drafted a bill enabling local Governments to license gins, and this will be placed before the Legislative Assembly presently. In the meantime I am collecting information regarding the practice of mixing and the possible means of dealing with it.

8. *Cotton auctions.*—Auctions of American cotton did good in the canal colonies in past years as they brought together large consignments of good quality lint for purchasers. Also the condition of sale that the best quality should be ginned under the supervision of the Agricultural Department ensured the provision of pure type seeds in large quantities for the next season.

As these cottons are now grown on such large areas, that good prices can be had for them in the Mandis, and the Agricultural Department can make arrangements for pure seeds with the large grantees in the colonies, auctions are not as necessary there now. In the Hansi Circle however the Deputy Director of Agriculture is pushing auctions for his Hansi cottons and in the past year got premiums of Re. 1-8-0 to Rs. 2-6-0 per maund over local cottons at his sales. He has great difficulty in getting sufficient seeds of the pure type to satisfy demands. The results of the 7 auctions held in the Province are tabulated in Annexure VII, pages 36-37.

One sale was held at Renala Khurd under the auspices of the Fauji Zamindara Association. The quantities of *kapas* offered were not large but prices obtained were good. The staff of the Agricultural Department assisted at this sale by classifying the various lots.

Arrangements have been made by the Deputy Director of Agriculture for the growing of pure type seeds in the neighbourhood of Hansi Farm, but he does not think, he will be able to guarantee the purity of the seeds from such crops until the proposed ginning plant is put up at Hansi. Unfortunately this case has been held up for want of funds.

9. *Cotton prices.*—Cotton prices at Bombay minus cost of freight to Bombay, ginning charges, etc., were posted daily in the principal cotton Mandis in the canal colonies as usual throughout the season and it is interesting to note that the local prices were sometimes Rs. 2 per maund more than the Bombay rates reduced to local terms. This seems to be connected with the mixing of Desi and American cottons which was so freely practised last year.

10. *Wheat.*—The rabi season was on the whole not a good one for wheats. The months of December, January and February were damp and cloudy throughout the Punjab. This stimulated growth of the crop but also greatly encouraged rust and smut diseases. Rust appeared in December instead of in January as usual, and multiplied with unprecedented rapidity. Conditions favourable for the disease continued late in the season and the excessive rust, by using up the foods stored in the plant, caused the wheat grains to be poorly developed and shrivelled.

Local hails fell in March and did great damage where they happened to fall. The damp season delayed harvesting for a fortnight or so, and in the south-east part of the Punjab

hot winds in March and April added to the damage done by rust. In most parts of the Province, heavy rains fell in May while the crop was on the threshing floor or in heaps awaiting threshing, and worked great havoc on the quality of grain, much of which germinated or rotted.

The area under our improved wheats in Rabi 1922-23 was estimated at about 9 lakhs of acres.

11. *Trials of 8-A and Punjab-11.*—As regards pure types of wheat, farmers now ask for either Punjab-11 or the comparatively recently distributed 8-A. The following statement shows the amounts of pure seeds of wheat purchased by the Department for resale to farmers in 1922 :—

Circle.	8-A.	Punjab-11.	Remarks.
	Mds.	Mds.	
Gurdaspur	8,339	...	Only 1,567 maunds could be sold.
Lyallpur	1,152	7,950	8-A all sold off while only 2,700 maunds of 11 could be sold.
Hansi	8,868	7	All sold.

In addition to this considerable quantities of pure seeds are stored by private individuals, etc., under the supervision of the Agricultural Department.

The demand for these pure type seeds was smaller in some cases than might have been expected, and the reason of this was that prices had fallen greatly from the time the wheats were harvested until the time they were sown, farmers held up stocks in the hope of a rise and in many cases a good deal of pure seed of these types was stored in their own homes at sowing times.

Comparative tests of these two wheats were carried on in all the three circles. The Deputy Director of Agriculture, Hansi, says that 8-A is now very extensively grown in all Districts of his circle expect in the Ambala Khadar, where Punjab-11 is still preferred. 8-A is already recognised as a separate class in some of the Mandis of his circle and fetches two to three annas premium per maund over the best local wheats. Pusa-12 is the favourite on the lands irrigated by wells in the neighbourhood of Panipat. In Ferozepore District it was grown on 6,000 acres.

The Deputy Director of Agriculture, Gurdaspur, states that Punjab-11 and 8-A are the premier wheats in the colonies as well as in the barani areas of his circle, and that the Sargodha Farm comparative tests of Punjab-11 and 8-A show, that 8-A is the heavier yielder. He estimates that nothing short of 40 per cent. of the total area of wheats in the Lower Jhelum Canal Colony is now under 8-A. He is disturbed because of the appearance of mottled grains in 8-A but this is simply due to some interference with the proper nutrition of the plant. It may be caused for example by poverty of soil, rust, lack of irrigation while the grains are filling, etc. This mottling of grain has occurred in many more places than usual in the year under report, and a large number of people, seeing this, believed that their wheat types had got mixed. If, however, these mottled grains are sown and the crop produced is healthy and well nourished, the grains will regain their normal character.

The Professor of Agriculture states that almost the whole of the crop of the canal colonies in his circle is Punjab-11 in various degrees of purity. 8-A, he says, has been growing steadily in popularity particularly in the Lower Bari Doab Colony, and the seeds of this type which he had bought were rapidly sold out. He has arranged to provide it in much larger quantity during the coming season. Figures given by some farmers who tested 8-A against Punjab-11 on their own lands show an average outturn of 2½ maunds of grain in favour of 8-A. On the Professor of Agriculture's farm, 8-A beat Punjab-11 in the 84 out of 91 comparative tests, and gave on the average 2 maunds of grain more than Punjab-11.

On the Botanical farm, a large number of crosses and selections were tested against each other as usual. The net result of those grown on the larger plots was that 8-A beat Punjab-11 by 3⅙ maunds of grain and 11¼ maunds of straw per acre, while Punjab-11 was second in the list.

It is of interest to note that work in tracing the root systems of wheats in the Botanical section shows that 8-A is the deepest rooted of the common wheats and that Punjab-14—a celebrated Barani wheat—stands next. This seems to be one reason why 8-A has regularly given better yields than Punjab-14 on barani lands at Gurdaspur for the last 7 years during which it has been tried there.

Searching tests in the Botanical section for the past decade have consistently shown that 8-A is a heavier cropper than Punjab-11, and after several years' trials on the various

departmental farms, and the lands of the private farmers we have reached a stage of general agreement that 8-A is a better yielder of both grain and straw on average quality of land either irrigated or unirrigated. At a moderate estimate it yields 1½ to 2 maunds of grain per acre more than Punjab-11 and with 8 to 10 million acres of wheat grown in the Punjab, 8-A should be of value to the Province.

12. *Milling tests.*—Milling tests of wheat were not proceeded with this year, as the operation is expensive and the quality of the grain was so destroyed by rust and rains that results got would not have been normal.

13. *Earcockle disease in wheat.*—Demonstration plots showing how farmers can by a simple method rid their fields of earcockle disease in wheat were conducted by the Ecoromic Botanist in co-operation with the Deputy Director of Agriculture, Hansi, in badly affected parts of Karnal District. This disease does damage to the extent of many lakhs of rupees per annum in the Province. With staff and facilities there is no difficulty in getting rid of it from any farm.

14. *Sugarcane.*—In the comparatively humid temperate climate at Gurdaspur sugarcane is an important crop and quite a large number of sugarcane varieties are being tested on the Gurdaspur Farm. The Coimbatore cane Co.-205 has done extremely well there on both irrigated and unirrigated lands and sets are in keen demand in Hoshiarpur, Jullundur, Amritsar, Gurdaspur and Sialkot Districts.

On the Professor of Agriculture's farm, Lyallpur, the Suretha variety of cane has now established its superiority over the local canes, and Co.-205 which was tried there for the first time has yielded the highest weight of Gur (92·3 maunds per acre) ever obtained on the farm.

The Deputy Director of Agriculture, Hansi, states that Co.-205 has done exceedingly well on the Hansi Station in the two years which it has been tried there. He gave it out last year to farmers in Rohtak, Karnal, Ambala and Hissar Districts, and yields were very satisfactory. This is a thin hardy cane and as such is very suitable for the Punjab, where farmers usually grow cane not only for gur making but as an insurance against fodder famine.

Thick varieties of cane are grown for chewing purposes near towns. The Striped Mauritius cane which is a thick

variety is reported by the Deputy Director of Agriculture, Hansi, to be doing well in Ferozepore.

Red rot disease in sugarcane.

15. Red rot disease on canes does great harm in Ferozepore District. The Ec onomic Botanist in co-operation with the Deputy Director of Agriculture, Hansi, has carried out, at Ferozepore, experiments on this disease, and demonstrations of the value of planting disease free sets, with the result that there is now a keen demand from farmers for disease free sets. Endeavours are being made to meet this demand.

16. *Seed Depôts.*—The allotments for the purchase of seeds made during the financial year 1922-23 were as follows :—

Allotments for wheat and cotton seeds for the year 1922-23.

Officer's Name.	Allotment for		Total.
	Wheat.	Cotton	
	Rs.	Rs.	Rs.
1. Deputy Director of Agriculture, Hansi.	60,000	32,000	92,000
2. Deputy Director of Agriculture, Gurdaspur.	65,000	16,000	81,000
3. Professor of Agriculture	90,000	48,000	1,38,000
Total ...	2,15,000	96,000	3,11,000

The total amounts of wheat and cotton seeds purchased for resale to growers were 25,694 maunds and 17,319 maunds, respectively.

The profit and loss account of wheat and cotton seed is shown in Annexures III and IV, page 32. The loss of Rs. 35,852 in wheat transactions is due to abnormally high prices at the time of purchase of the wheat seed, and the subsequent fall in wheat prices at sowing time. Cottons show a profit of Rs. 12,675, therefore the difference was a loss of Rs. 23,177. In the previous year, however, there was a gain of Rs. 32,720 on wheat and cotton seed transactions, and in considering the present year's deficit we have also to remember the very great gain to farmers by being supplied with good seeds of pure types. The profit and loss accounts do-

not contain any charges for establishment. No special staff is engaged for these depôts ; the work is done by the ordinary staff of the Department. The question of enlisting private and co-operative enterprise is receiving attention.

17. *Implements.*—Annexure VIII page 38 shows the sales of implements manufactured in India, imported implements and of those manufactured by the Agricultural Department. The demand for these improved implements is increasing rapidly, and is an indication of the advantages derived from using them.

The District Board, Gurgaon, which is fortunate in having an exceptionally energetic Deputy Commissioner in the person of Mr. Brayne, purchased no less than 500 Rajah ploughs. The Deputy Commissioner, Ferozepore, convinced of the popularity of Meston ploughs in his district obtained Government sanction to the grant of Rs. 7,000 for taccavi to purchase these ploughs. The District Board will buy the ploughs and issue to farmers who ask for them. The District Board of Sheikhupura indented for 6 Rajah ploughs, 4 horse hoes, and 7 fodder cutters in order to sell them to its members at half the cost price.

I have used my influence with agents of manufacturing firms to bring down the prices of implements as far as possible, and firms have readily co-operated.

Important improvements in agricultural implements have also been made by officers of the Agricultural Department, see reports of experts in Appendices.

The machinery depôts at Lyallpur and Gurdaspur are doing well. A machinery depôt at Hansi has recently been sanctioned. On the Lyallpur Agricultural Farm, data are being collected of the amount of work done in unit time by power machinery and the costs of that work, so that information on these points may be available to farmers.

Agricultural Associations.

18. The agricultural associations are doing very good work. The attendance and interest taken in these meetings are good. Papers are contributed by members on the subjects in which they are specially interested. Instructive lectures on crop pests illustrated by lantern slides are sometimes also given.

Demonstrations and Exhibitions.

19. A special feature of our propaganda work now is the exhibition of improved seeds, implements, etc., at the annual horse and cattle fairs in the Province. Practical demonstrations with implements are

given, leaflets are distributed freely, and advice is given to all enquirers. These exhibitions excite a great deal of interest. Demonstration plots on farmers' own lands are being pushed on in all circles. This is one of the most convincing methods of demonstrating to farmers the advantages of growing improved crops and of adopting modern methods.

As a consequence of requests from farmers, the Deputy Director of Agriculture, Gurdaspur, has in addition to his ordinary district work chosen a few villages to which special attention is being given.

Seed and Demonstration farms.

20. To the Government seed and demonstration farms at Sargodha, Montgomery and Chillianwala, a farm at Beas has recently been added. It was formerly financed by the District Board, Amritsar.

Demonstration farms belonging to District Boards but supervised by Agricultural Department staff exist at Gujrat, Sialkot, Raewind, Jullundur and Rohtak. For the Khalsa College Amritsar farm, the Managing Committee have recently obtained the services of Bhai Lal Singh, M.Sc., a Punjabi who gained a degree in Agriculture in California. Our Agricultural Assistant who was previously in charge of the farm there has been sent back to the Agricultural Department. The court of wards farm at Jallalabad, in the Ferozepore District, the Montgomery and Lahore Jail farms and other small farms are receiving the attention of the Agricultural Department. An account of these farms will be found in the reports of the Deputy Directors of Agriculture, Gurdaspur and Hansi and the Professor of Agriculture, *vide* Appendices. On account of financial stringency, the starting of work on the rice farm at Kala Shah Kaku could not be sanctioned. This is at present on lease.

For the same reason the question of starting farms in the south-west and the north of the Punjab could not be taken up. Negotiations for securing land for demonstration farms at Gurgaon and Karnal are on foot, and I hope to be able to send up definite proposals shortly.

An area of 2,546 acres comprising villages 27 and 30 of 1. A. L. and one chak of 26 I. A. L. in the Lower Bari Doab Canal Colony was earmarked this year for the development under the Agricultural Department. It was, however, enjoined that no farm should be started at present on the area in question.

Demonstration work on co-operative and private farms is being extended.

A summary of the income and expenditure on the various demonstration and seed farms is given in Annexure No. XI, page 42. From this it will be seen that out of 14 farms 3 are working at a loss and 11 at a profit. Those working at a loss are Gujrat District Board farm, the Beas (Government Demonstration Farm) and the Jallalabad Farm in the Mamdot Estate. At the Gujrat Farm, poverty of the soil with light rains in Kharif and excessive rains during Rabi completely destroyed 5½ acres of gram, and reduced the outturn of wheat. This was followed by a great drop in prices, and the result of all these happenings was chiefly responsible for the deficit in the accounts. The farm has, however, made great progress in the past two years and it is hoped that by another year it will pay its way.

Only a small portion of the Beas Farm is under irrigation. The remaining is all barani and covers a considerable area under deep pits and uneven lands, the levelling of which has been a great strain on the labour bill of the farm. On the Jallalabad Farm, the lands were flooded and Rabi crops could not be sown; then the crop of rice failed on account of rice bug. This farm is, however, doing very good work in supplying seeds, etc., to farmers.

The profits from the 11 other farms varied from Rs. 67 to Rs. 7,881 per form.

I would like to point out, however, that on demonstration farms an inferior variety of crop must be grown alongside of a good, before the advantages of the latter can be effectively demonstrated; similarly with diseased and healthy seeds. Also far more labour is required to handle demonstration plots properly, and to keep records of results, than any ordinary farmer would employ. Therefore these farms may be doing valuable work for their localities even though they are not running at a profit. Indeed if the profit point of view is pressed too hard, there will be a temptation to run these farms more for profit than for utility to the Province.

Section III.

Economic Botany.

21. The Economic Botanist's report will be found in Appendix II on pages vii—xvi. The chief work of this section is the evolution of improved crops. Improved varieties of cottons, wheats, grams,

Improved crops.

barleys, dates, etc., are now in the hands of growers, and large number of newer varieties are under trial on the Botanical farm and elsewhere. Varieties have also been given out to farmers. The merits of some of these have already been discussed under district work, and need not be repeated here.

Thirty samples of American, and 11 samples of Desi cottons were sent to Messrs. Tata & Sons, Limited, Bombay, for valuation. The best of the Americans spun 50s and were valued at Rs. 750 to Rs. 780 per Kandy (784 lbs), while the worst of these spun 24s to 34s and were valued at Rs. 625 to Rs. 640 per Kandy. 4-F was one of these which spun 24s. Middling American was at the same time valued at Rs. 775. Of the Desis, Sanguinium No. 27 stood first. It spun 14s and was valued much above the other Desi samples.

In this connection, it is of interest to know, that 4-F. which made the growing of staple cotton possible in the Punjab, has been selected by the Sindh Cotton Committee as the basis of cotton work in Sindh. 4-F. has been grown in Sindh for a number of years and 285-F. is now to be tested there. The latter type will, I think, be infinitely better for their purpose than 4-F. The Central Cotton Committee have decided to provide funds for cotton research in the Punjab, and an expert who will devote his whole energies to cotton work here is expected soon.

Improved varieties of Potatoes in the Simla *Hills* gave a profit of Rs. 177 per acre over the local variety. The date palm plantation at Muzaffargarh has yielded a small profit this year, and as the trees get older, we expect it to yield greater profits.

Another important part of the work of the Botanical Section is the study of factors influencing the quality and quantity of crops got. Mention has already been made of the cause of the cotton trouble in 1919 and 1921 and the effect of rains on wheats when flowering is described below. Pollen grains of both cottons and wheats burst like bombs on a battle front when a drop of water is placed over them, and a study of the effects of showers of rain on these crops when in flower is very important.

22. *Crop testing.*—I have read with interest the remarks made in last year's annual report by Mr. Jacob regarding the number of duplicate plots to be sown with each variety of crop in order to establish that a given superiority of mean yield is not due to chance with a probability of 30 to 1.

I do not wish to raise a controversy in annual reports, but I may say, experience has shown that type testing is not a simple matter of mere duplication of plots. For example, I have seen 4-F. and 285-F., interstripped in a large number of adjacent plots,, and 4-F. outturn beating 285-F. every time. But the cotton lines had been sown the same distance apart in both cases, and as these cottons have quite different habits, there could be no accurate comparison of outturns per acre even if the plots had been duplicated to infinity.

In the case of wheats again, it will be interesting from what has been said already that if a shower of rain falls when a certain wheat is in flower, instead of a week later when its competitor is in flower, the relative outturns of grain got may be quite misleading whatever the number of plots may be. Again if all plots of different types of crop got irrigations on one day, the results may be misleading, as all these types may not be at the same stage of development on the date of the irrigation. The number of pitfalls in type testing operations are extremely numerous and varied, and experience has shown that for practical purposes we must not rely on outturn alone to enable us to "spot" a superior type from amongst a multitude of others. We certainly want a considerable amount of duplication of plots, but there is no doubt that the consideration of outturns from any number of duplications cannot give certainty of spotting an improved variety without undue delay, as variations in land are a small factor as compared with numerous other factors concerned, and therefore for practical purposes it is only when the outturn figures are *accompanied by a correct diagnosis of the case* that we are guided to really improved varieties. Experience annually emphasises that what is wanted to reduce the length of controversies as to whether a type of crop is an improved one is facilities for those who evolve the types to test them to a decisive stage themselves. These men know the characteristics of the types they evolve and are much less likely than other people to fall into the pitfalls above referred to. Arrangements to meet this want are on foot.

Agricultural Chemistry.

23. For the report of the Agricultural Chemist, see Appendix III on pages xvii—xxiv. Two hundred and fifty-six samples of various kinds were analysed for private individuals and other departments,

Analyses.

and 376 individual samples were analysed in connection with chemical investigations going on in the laboratory.

Bara Reclamation.

24. The Ganji Bar Experimental Station at Kahuta is intended for Bara reclamation work and so far has been under the control of the Agricultural Chemist. No definite information can yet be given as to the prospects of ultimate reclamation, but it is encouraging to note that "treated" bara lands are giving much better crops than the "Virgin" bara soil.

The Retrenchment Committee of the Provincial Legislative Council which met early in 1923 recommended the continuation of the farm only on the condition that the expenditure should be reduced to Rs. 30,000 per annum. Every effort is made to keep the expenditure within this limit. A full account of cultivation, etc., is given in part 2 of the Annual Report of the Agricultural Department.

It has been decided to place Mr. Johnston, Deputy Director of Agriculture, Lyallpur, in direct control of the farm on his return from leave under the guidance of an advisory committee consisting of the Director of Agriculture, the Agricultural Chemist and Mr. Henderson, Imperial Agriculturist, who has had experience of saline reclamation in Egypt and Sindh.

Sullage experiments.

25. Sullage experiments have now been carried on at Lyallpur for about five years, but progress has been greatly hindered on account of the uneven fertility of the land and the very limited area of the farm. So far the results obtained indicate that full sullage as obtained from the city is very beneficial for fodder crops, for example maize, and such vegetables as cauliflower. It appears to be somewhat injurious to carrots and turnips, as the plants produced had a bitter taste, and showed considerable rotting. In such cases 50 per cent. strength of sullage appear to be most beneficial. The Sanitary Board contributed a sum of Rs. 930 towards repairs and running the experiments of the farm.

Green manuring.

26. The results of green manuring have been published in the form of a bulletin. Experiments were started in 1917. The residual effect only of the green manuring is being studied. Results obtained this year confirm the opinion that the application of green manure to sandy soil is more profitable than to stiff soil, and that the residual effect of green manuring in a sandy

soil is quite marked even in the 5th year while the effect has disappeared in a stiff soil before that time.

Soil fertility.

27. Work on nitrogen fixation is being carried on on lines similar to those of previous years, but the amount of nitrogen added to, or lost from, the soil owing to natural causes is now estimated from month to month. This is very important, as the fixation and the nitrification figures appear to vary enormously from month to month. Work has also been done on soil bacteria and protozoa with special references to nitrogen fixation; on the effects of different manures; the manurial value of wheat dust; the detection of small quantities of phosphates in soils, etc.

28. *Food values.*—Investigations into variations of the nutrient constituents of oats and wheats and the digestibility of certain animal fodders, *viz* :—Bhusa, gram, maize and shisham leaves are in progress.

Entomology.

29. The report of the Entomologist to Government will be found in Appendix IV, pages xxv—xxxi. This officer is anxious for the development of his section, and points out the lack of an insectory, and the very limited number of his staff. The insectory is badly wanted and I hope that funds will be found for it early; also certain additions to his staff are necessary, but in spite of this he has been able to turn out a good deal of very useful work.

Seven original papers dealing with work done in the section were published. Entomological exhibitions were held on seven different centres, and four popular lectures illustrated with lantern slides were given. A good deal of district work in combating various farm pests was carried on, but the Entomologist feels his efforts limited in this work by paucity of staff.

I agree that one Agricultural Assistant sufficiently trained in Entomology to be able to carry out remedial measures should be stationed on each agricultural farm. A class to train our present assistants for this work is being arranged.

Work was done on spotted boll worm (Earias insulana) and particular attention was paid to parasites. The Entomologist doubts the efficacy of parasites in checking the disease. This boll worm which is the common boll worm

of the Province did not do much damage this year. The pink boll worm (Platyedra gossipiella)which is looked on as a minor pest in the Punjab but is a most serious pest on cottons in some other countries, was found by the Entomological staff in alarming numbers in Sialkot and Ferozepore Districts. Further investigations on this case are being carried on.

In order to assist in exterminating cotton stem borers, the Entomologist asks for legislation to enforce farmers to remove cotton sticks from the fields after the *kapas* has been removed. This question will be ventilated at the next meeting of the Provincial Board of Agriculture.

Further study of moth borers in maize, jowar, and sugarcane confirm the belief that the remedy lies in the uprooting and burning of the stubbles before the end of March each year.

With the spread of citrus fruit growing in the canal colonies, the Psylla and Aleurodidae insect pests are spreading at a rapid rate, and the Entomologist suggests a special Agricultural Assistant being put to citrus pest work with a staff of field men for spraying.

The Entomologist finds that superheating is a very effective and economical way of dealing with insect pests in stored grains. Experiments on air-tight storage have so far yielded no practical results.

A vigorous campaign against rats was carried out in some villages very severely infested. Poisoning and fumigation gave very satisfactory results.

30. *Sericulture.*—The amount of silk seed distributed in the Province during 1922-23 was 1,392 ounces as against 2,845 ounces distributed in 1921-22. In spite of a decrease in the amount of seed distributed, the output of silk cocoons is the same as last year. The rearers now understand that it is not much good going in for larger quantities of seed than they can manage, and they realise that an ounce well reared pays better than a couple of ounces badly reared. The quality of the cocoons was, on the whole, very good, and the prices realized were high: the produce of the best rearers fetched Rs. 242 per maund, of dry cocoons.

A silk exhibition and auction was held at Gurdaspur on 26th and 27th May 1923. About 300 people attended and Rs. 480 were given as prizes. The exhibition is becoming very popular and is serving a very useful purpose in bringing the producer and buyer together.

Mulberry plantations on the waste banks of the Upper Bari Doab Canal have been extended. About 7,000 seedlings were transplanted during 1922-23. The plantations are in excellent condition and were used for rearing silkworms this year. The plantations at Kot Nainan, Sujanpur and Behrampur previously under the management of the District Boards were taken over during the year under report by the Department of Agriculture and are being improved.

Agricultural Engineering.

31. The report of the Agricultural Engineer will be found in Appendix V on pages xxxii—l. The total value of the work done in the workshop during the year amounted to Rs. 94,000, and yielded a profit of Rs. 5,000 round. The work is supervised entirely by working staff and the engineer considers that there is a considerable waste owing to lack of supervision. With proper supervision which would be possible by the appointment of a Sub-Divisional Officer or Extra Assistant Director of Agriculture as Manager, considerable saving would be effected. Proposals for more staff are being dealt with separately. The Agricultural Engineer has to devote much of his time to teaching work and the duties of Principal of the Agricultural College. Therefore additional staff is an urgent necessity to enable him to carry on his work satisfactorily.

Well boring in ordinary wells.

32. The number of wells bored was 273 as compared with 343 during the previous year. The percentage of success being 80·2 against 82·2 last year. The number of strainers sunk is 61 compared with 72 in the previous year. The decline in the number of wells bored is considered by the Agricultural Engineer to be due to the continued use of inefficient boring plant, as this plant requires a long time for the execution of the work. The plant is now being replaced by an improved type invented by the Agricultural Engineer. Considerable saving in time, labour and expense in carrying out borings is now expected. The power boring plant invented by the Agricultural Engineer has been placed on the market, and is in use. It costs one-third of the price of the imported power plant and requires less labour.

The scheme to put boring work in the Punjab on a self-paying basis was approved in principle by Government in September 1922. As a step towards this, Government has,

for the present, approved of an overhead charge of Rs. 50, only to be levied for every successful bore made. I understand that if the overhead charge be increased to Rs. 100, it would completely cover Government costs and I think, this ought to be levied as early as possible. A Sub-Divisional Officer is urgently needed for supervising boring operations.

Tube Wells.

33. On account of the high costs of plant and the decline in market price of grain, etc., no new work on installations of tube wells was taken in hand. The tube wells in Bahawalpur State and Dera Ismail Khan were completed in the year under report. As is stated in Mr. Brownlie's report, a sum of Rs. 14,000 has been credited to Government for depreciation of plant and departmental charges. The scheme of sinking wells in Government waste near Jhang had to be dropped in view of the expense. Several proposals for irrigating large tracts of land by batteries of tube wells have been investigated, and a scheme for pumping water from the sub-soil in the water-logged district of Gujranwala was drawn up and submitted to the Irrigation authorities. Other schemes were also dealt with.

Owing to the failure of a private company to instal an electric plant in the city of Lyallpur, the question of the completion of the College tube well had to remain in abeyance. Electric power is also very badly needed for driving the workshop machinery. Several machines purchased years ago and which are primarily designed for electric plant cannot be used. Proposals will be submitted to Government for sanction to instal an independent source of electric current for the Agricultural college.

Miscellaneous.

34. Want of staff prevented undertaking the substitution of small size stone strainers for the copper strainers at present in use in ordinary boring works. The stone ware strainers are much cheaper than the copper ones.

A Persian wheel has been designed in which the three wheels are interchangable. This will lengthen the life of the complete out-fit. The wheels are of metal and expensive, however. Efforts are being made to reduce the cost.

Section IV.

The Lyallpur Wheat Elevator.

35. The Lyallpur Wheat Elevator has not been a success so far. It cost 7 lakhs of rupees and has a capacity of storing about one lakh of maunds of grain. It started work on 14th of June

1920 and Messrs. Clements Robson & Company have run it for Government for a sum of about Rs. 16,200 per annum since then. This includes staff, oil, coal, etc.

In the year under report, about 30,000 maunds of wheat was stored in the elevator, but the prices of wheat were—

Rs. 5-1-4 on 14th May 1922,

Rs. 4-11-0 on 14th October 1922, and

Rs. 4-0-6 on 14th February 1923.

Therefore those who stored wheat in it must have lost money. This will cause disappointment with the elevator as a store house of grain. In normal years, the price of grain usually rises between harvest and the end of the year, so that the experiences of the past year are not representative. The elevator cannot be expected to pay as a mere store house however.

It is fitted with very perfect grain cleaning machinery and incidentally I may mention that earcockle disease of wheat will practically disappear if farmers in affected areas will purchase seed wheats from the elevator. This is because the galls which cause the disease are practically all removed by the elevator grain cleaning machinery. We have found several farmers losing as much as 75 per cent. of their crop by this disease, and hundreds of cases of lesser loss. Investigations have shown that earcockle causes a loss to the Province of many lakhs of rupees per annum.

But the main use of the elevator must be in the export trade, as one of a system of elevators in the country, and I take it that the main reason for building it was to obtain information which would throw light on whether a system of elevators would be of use in Upper India. A single elevator in the Punjab could never pay, but by shipping consignments of properly dressed and graded wheats from it to London we could get information as to what premium can be expected from elevator wheats, and this is an improtant item when attempting to work out whether an elevator system will pay.

No commercial consignments of elevator wheat have yet been exported from the Punjab. Export of wheat was stopped by Government in April 1919. From October 1920 till the end of March 1921, Government allowed the export of 4 lakhs of tons. Then the embargo continued till September 29th, 1922. The high prices and falling market of 1922-23 made conditions very unfavourable for trial exports to be

made in that year. Unfortunately the crop harvested in April 1923 was more or less severely damaged on the threshing floor by rains, and differences in prices to be got from consignments exported would more likely be measures of differences in damage done to the grain by those rains than differences in prices that might be expected between elevator and ordinary market wheats in normal years. We had therefore better wait for another crop before test experiments are made.

Hand samples of elevator wheats were valued on the London market in 1921 at about Re. 0-4-0 per maund higher than the best mandi wheats (choice white Karachi) but it is essential to have a series of commercial consignments of properly cleaned and graded wheats sent to London before we can have reliable information on the premium to be expected. To get this information a scheme is under consideration to export about 30,000 tons of first class colony wheats at the rate of about 2,500 tons per month, and in parcels of about 500 to 1,000 tons at one time to minimise risks of loss through fluctuations in market prices. We hope that arrangements will be made to carry this proposal into effect by the time the new crop is harvested.

Exporters have emphasised to me that although India is one of the first class wheat exporting countries in the world (India exports about $\frac{3}{4}$ of a million tons of wheat per annum) it exports its wheats under the conditions of a 10th rate country. They point out for example, that the quality and therefore the final value of a consignment of Indian wheat exported to London is fixed in London and not in India as it ought to be. It shares this distinction with such backward countries as China and the Persian Gulf. In advanced countries like Australia, United States of America, etc., the quality of the wheat is fixed for both sellers and buyers in the country of origin.

This eliminates one of the most uncertain factors of the sale of produce, and enables exporters to give the producer a higher price for his wheat with safety to themselves. At present the exporter has to keep a considerable margin (about 1 per cent. I am told) of the value of wheat in hand against the possibility of an adverse decision from London. This margin would not be necessary if the final decision as to the quality of the wheat was made in India. The money that would be saved thus to growers comes to many lakhs of rupees per annum (over 8 lakhs per annum with wheat at

Rs. 4 per maund). Again even if elevators are not found to be justified, the experience gained by sending consignments of elevator wheats to London will probably lead to the discovery of the correct lines on which to work, to give the Indian producer conditions of sale compatable with his importance as a contributor to the food supply of the world.

The Lyallpur elevator therefore represents the beginning of an effort to do for the producer what Governments the world over have done, or are striving to do, for their producers.

Concluding observations.

36. Practically all the schemes mentioned by Mr. Jacob on pages 12 and 25 of last year's report are still "in the air." The want of some of them is crippling the Department's activities greatly.

The fact that there is a keen demand for—

(*a*) supply of varieties of seeds of wheat and cotton evolved by the departmental experts,

(*b*) the introduction and demonstration of improved agricultural methods and modern implements suited to local conditions, and

(*c*) the institution of demonstration farms and plots,

is in itself a proof of the good work done by the Department.

But much remains to be done. Nearly half the Province still knows the Agricultural Department only by name; districts are calling out for men, but we have none to give them. Ludhiana has a demonstration farm with no Agricultural Assistant in charge of it, and probably therefore it is doing more harm than good. There is an urgent demand for agricultural assistants in Gujranwala and in other districts. The South-West Punjab Agricultural Circle must come into existence soon, and it will need at least 4 men. A great expansion of the departmental area is about to take place at Lyallpur, and a similar expansion is to take place at Sargodha. The area of the Hansi Farm has also been added to recently. All this means extra staff, and we require at least 12 Agricultural Assistants immediately. Only 6 have been asked for however in view of the financial stringency. The demand for Mukaddams is also keen.

The splitting of the Deputy Directors of Agriculture circles in pursuance of the recommendations of the Indian Cotton Committee of 1917-18 is being delayed for want of funds.

The curtailment of Travelling Allowance allotments has greatly hampered the activities of the Agricultural Department.

Preparations are being made for sending exhibits to the Empire Exhibition in London in 1924. Appearances indicate that we are to have a very good show there.

The orders of Government on last year's report are receiving attention, but here again we are greatly hampered for want of funds. Increased attention to the improvement of fodder crops cannot be given until we have staff and facilities for dealing with this important case.

With regard to the Hon'ble Minister for Agriculture's suggestion in last year's report that at agricultural farms a part should be set aside as a model farm whereby the development of intensive agriculture and such subsidiary occupations as poultry and bee keeping, fruit growing and dairying, the possibilities of increasing the economic outturn of small holdings, can be demonstrated, I would say that the matter is receiving attention.

With regard to the suggestion made in paragraph 9 of Punjab Government review of last year's report, I may say that existing pleasure gardens might be utilized for improving vegetables, flowers and garden produce. It should be borne in mind, however, that many of these pleasure gardens are at present known as *Company Baghs* which exist at district head-quarters and experience led Mr. Townsend to think that although the suggestion is worth following up, it may not be altogether easy to give effect to it, so far as District Board gardens are concerned owing to the fear of District Boards and Deputy Commissioners that the Agricultural Department wishes to replace them in the eyes of the public as the managers of these popular institutions. To put it plainly Deputy Commissioners and District Boards generally dislike to have their functions and authorities as regards these *Company Baghs* interfered with. Enquiries have been made from all District Boards in the Punjab as regards available areas and the scope for fruit and vegetable culture in the Province, but we have no expert on fruit and vegetable culture in the Agricultural Department at present and it would be hopeless to expect success with the work until one is appointed. An expert of this sort in the Agricultural Department is sorely needed now as fruit farming is increasing greatly in popularity and we have to deal with many inquiries from the public ; also we have to supervise fruit farm grants

now existing in the Province and deal with problems which arise therefrom. From my experience of the small amount of work I have done on fruits and what I can see around me, there are immense possibilities for improvements in fruit and vegetable growing in the Province and I consider the appointment of a fruit expert an urgent necessity now.

Acknowledgments.—As already stated, I have only touched on a few points of the work of the Department, and a perusal of the reports of the various experts, *vide* Appendices I to VIII is necessary in order to get an idea of the extent and value of that work to the Province. In addition to the mass of research which is being carried out by the Department in all directions, practical results already achieved by giving farmers improved varieties of main crops and improved implements, by demonstrating improved methods of agriculture, by combating diseases, by inventions which have brought down the cost of well boring machinery, etc., etc., must be worth crores of rupees per annum to the Province.

Each report will speak for itself, and I merely wish to draw attention to the fact that the Province is deeply indebted to the officers in charge of the various sections of the Department, their staffs, and to the officials in other Government departments and private persons who have so kindly assisted them.

D. MILNE,

Officiating Director of Agriculture, Punjab.

Dated 6th January 1924.

ANNEXURE I.

Statement showing the results of the Agricultural College passing out examination from the year 1914 onwards.

Year.	Class.	Number examined.	Number passed.	Agriculturists.	Non-agriculturists.	Total.
1914 ...	3 years' course ...	10	9	4	5	9
1915 ...	Ditto ...	14	14	6	8	14
1916 ...	Leaving Certificate (2 years' course)...	19	19	7	12	19
1917 ...	Ditto ...	20	20	12	8	20
1918 ...	Leaving Certificate 4 years' course ...	34	34	26	8	34
		6	6	2	4	6
		40	40	28	12	40
1919 ...	Leaving Certificate 4 years' course ...	14	14	11	3	14
		4	4	3	1	4
		18	18	14	4	18
1920 ...	Leaving Certificate 4 years' course ...	8	15	13	2	15
		20	17	10	7	17
		33	32	23	9	32
1921 ...	F. Sc. (Agriculture)...	26	17	13	4	17
	B. Sc. (Agriculture)	11	6	4	2	6
	Leaving Certificate	23	17	16	1	17
		60	40	33	7	40
1922 ...	F. Sc. (Agriculture)	36	33	29	4	33
	B. Sc. (Agriculture)	27	14	10	4	14
	Leaving Certificate	17	10	9	1	10
		80	57	48	9	57
1923 ...	F. Sc. (Agriculture)...	27	14	13	1	14
	B. Sc. (Agriculture)	24	18	17	1	18
	Leaving Certificate	13*	12	10	2	12
		64	44	40	4	44

* One was a casual student.

ANNEXURE II.

Statement showing disposal of silkworm seed imported during the last 6 years.

Year.	Total silkworm seed imported and distributed in ounces	Number of rearers.	Yield of dry cocoons per ounce of seed. (seers).	Average price realized per ounce of seed.	Price per maund of dry cocoons.	Number of districts in which sericulture was practised.
				Rs. A. P.	Rs.	
1918 ...	506	165	6 to 20	20 9 4	120 to 190	8
1919 ...	472	206	1/5 to 5	3 5 4	190 to 200	9
1920 ...	600	301	6 to 17	32 5 7	227	12
1921 ...	1,762	359	2	9 3 0	211-8-0	15
1922 ...	2,825	886	5 to 19	48 6 0	170 to 250	17
1923 ...	1,400	608	5½ to 18½	49 0 0	170 to 212	14

ANNEXURE III.

Profit and Loss account of wheat seed depôts in the Punjab for the year ending 31st March 1923.

Name of depôt.	Quantity purchased.	Purchase money including incidental charges and outstandings.	Sale money and recoveries from last year's transactions.	Profit or loss.	Remarks.
	Mds. S. Ch.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Hansi depôt	8,978 17 9	72,220 2 4	64,254 9 9	7,965 8 7	Loss (unaudited).
Lyallpur ...	3,308 38 0	23,633 5 3	18,519 8 0	5,113 13 3	Loss (audited).*
Montgomery	5,068 0 0	30,175 11 3	22,272 4 0	7,903 7 3	Do.
Gurdaspur	8,338 36 0	61,595 6 1	46,726 2 4	14,869 3 9	Do.
Total ...	25,694 11 9	1,87,624 8 11	1,51,772 8 1	35,852 0 10	

NOTE.—Value of stock (seed and bags) including outstanding balance of 1921-22 in hand on 1st April 1922 has been added to purchase money. Similarly value of stock in hand on 31st March 1923 has been added to sale money.

*725 maunds not accounted. They will come into next year's report.

ANNEXURE IV.

Profit and Loss account of cotton seed depôts in the Punjab for the year ending 31st March 1923.

Name of depôt.	Quantity purchased.	Purchase money including incidental charges and outstandings.	Sale money and recoveries from last year's transaction.	Profit or loss.	Remarks.
	Mds. S. Ch.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
Hansi depôt	3,009 18 0	28,677 9 2	28,693 9 5	16 0 3	Profit (unaudited).
Lyallpur ...	4,661 18 0	39,575 13 9	41,344 13 9	1,769 0 0	Profit (audited).†
Montgomery	4,361 31 0	43,625 4 0	52,570 2 0	8,944 14 0	Ditto.
Gurdaspur	5,286 0 4	44,504 1 0	46,449 11 9	1,945 10 9	Ditto.
Total ...	17,318 27 4	1,56,382 11 11	1,69,058 4 11	12,675 9 0	

NOTE.—Value of stock (seed and bags) including outstanding balance of 1921-22 in hand on 1st April 1922 has been added to purchase money. Similarly value of stock in hand on 31st March 1923 has been added to sale money.

†Five maunds not accounted for. They will come into next year's report.

ANNEXURE V.

Statement showing sowings of wheat (Punjab-11) in Canal Colonies in the Punjab. (This wheat was officially given out to farmers in 1913.)

Name of Colony.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.
	Acres.	Acres.	Acres	Acres.	Acres.	Acres.
Lower Chenab Colony	100,000	150,000	220,000	250,000	350,000	380,000
Lower Jhelum Colony	45,000	50,000	55,000	70,000	70,000	60,000
Lower Bari Doab Colony	50,000	100,000	100,000	311,000	324,966	305,095
Upper Chenab Colony	1,500	2,500	2,500	3,000	5,000	5,700
Total ...	196,500	302,500	377,500	634,000	749,966	750,795

Statement showing sowings of wheat 8-A. in Canal Colonies of the Punjab. (This wheat was given out to farmers officially in 1919).

Name of Colony.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Lower Chenab Colony	...	18	75	248	267	3,000
Lower Jhelum Colony	...	...	500	3,375	21,000	50,000
Lower Bari Doab Colony	...	...	30	200	1,570	2,000
Upper Chenab Colony	...	...	...	...	...	...
Total ...	...	18	605	3,823	22,837	55,000

ANNEXURE

Figures of sowings of

Year (Crop in—)	Lower Chenab Colony.			Lower Bari Doab Colony.			Upper Jhelum Colony.		
	American.	Desi.	Total.	American.	Desi.	Total.	American.	Desi.	Total.
1915-16 ...	6,000	147,471	153,471	500	18,093	18,593	...	...	...
1916-17 ...	30,000	143,467	173,467	13,000	26,682	39,682	...	2,307	2,307
1917-18 ...	120,000	114,454	234,454	80,000	6,356	86,356	...	20,264	20,264
1918-19 ..	190,000	125,067	315,067	152,105	...	152,105	1,000	21,888	22,888
1919-20 ...	226,693	122,558	349,251	172,648	44,489	217,137	6,000	33,693	39,693
1920-21 ...	273,261	68,938	342,199	227,121	51,714	278,835	10,000	34,676	44,676
1921-22 ...	178,653	53,219	231,872	177,609	13,425	191,034	42,733	9,580	52,313
1922-23 ...	113,398	92,899	211,297	164,327	34,574	198,901	24,980	13,025	38,005

Note—(1) American Cotton figures from 1915-16 to 1920-21

(2) Desi Cotton figures from 1915-16 to 1920-21 have been

(3) The total figures are those as published by the

(*a*) These figures include a small

VI.

Cotton in Canal Colonies.

Lower Jhelum Colony.			Other Districts.			Grand Total.		
American.	Desi.	Total.	American.	Desi.	Total.	American.	Desi.	Total.
1,200	10,171	11,371	...	...	289,758	7,700	(a) 465,493	473,193
7,000	44,641	51,641	...	...	332,266	50,000	(a) 599,363	649,363
11,500	64,801	76,301	...	...	531,751	211,500	(a) 737,626	949,126
16,000	73,942	29,942	...	...	506,046	359,105	(a) 726,943	1,086,048
60,000	52,906	112,906	...	...	808,381	465,341	(a) 1,062,027	1,527,368
100,000	8,258	108,258	95,000	667,171	762,171	705,332	830,757	1,536,139
64,211	12,789	77,000	22,785	331,946	354,731	485,991	420,959	906,950
42,062	20,759	62,821	15,829	374,106	389,935	365,596	535,363	900,959

have been taken from the reports furnished by Agricultural Officers.

obtained by subtraction from total figures published by the Irrigation Department.

Irrigation Department.

quantity of American Cotton.

ANNEXURE No. VII.

Statement of Cotton auctions held by the Agricultural Department during the year 1922-23.

1	2	3	4			5			6			7		
			4-FAMERICAN.											
			QUALITY SPECIAL CLASS PURE FOR SEED.			QUALITY A CLASS PURE NOT FOR SEED.			QUALITY A CLASS UP TO 1 PER CENT. DESI.			QUALITY B CLASS OVER 1 PER CENT. DESI.		
Serial No.	Places.	Date on which auction held.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per Maund.	No. of buyers.
			—	Rs. A. P.			Rs. A. P.			Rs. A. P.			Rs. A. P.	
1	Hansi ...	8th November 1922.	...	...	...	...	...	...	...	...	...	...	...	...
2	Hansi ...	15th November 1922.	...	...	...	...	...	...	...	...	...	...	...	...
3	Jaranwala ...	18th December 1922.	1,772 11 0	17 2 0	1	961 31 12	17 0 0	1	523 11 14	16 15 0	1	207 33 8	16 15 0	1
4	Baha-ud-Din...	20th December 1922.	...	...	...	2,015 0 0	Not auctioned.	...	1,317 0 0	Not auctioned.	...	141 0 0	17 4 0	5
5	Sargodha ...	5th January 1923	1,436 0 0	19 14 0	3	533 0 0	19 12 6	3	1,639 0 0	19 11 6	3	300 0 0	19 4 0	3
6	Phullerwan ...	10th January 1923	...	...	...	210 0 0	20 8 0	3	917 0 0	20 4 6	3	426 0 0	20 2 9	3
7	Lyallpur ...	15th January 1923	...	...	...	...	...	...	603 11 6	22 6 0 to 22 12 0	1	...	...	...

ANNEXURE No. VII—CONCLUDED.

Statement of Cotton auctions held by the Agricultural Department during the year 1922-23—concluded.

1	8			9			10			11	12	13
	Unclassified Cottons (American).			285-F. Cotton.			Desi Cotton.			Grand total of columns 4=10 (total sales).	Total quantity brought in auctions.	Remarks.
Serial No.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	Rate per maund.	No. of buyers.	M. S. Ch.	M. S. Ch.	Name of buyers.
		Rs. A. P.			Rs. A. P.			Rs. A. P.				(1) Messrs. Ralli Bros. (2) Messrs. Sher Singh, Raghbir Singh. (3) Messrs. Bhagat Ram, Ram Narain, (4) Messrs. Mohan Lal, Vikram Lal. (5) L. Bhakhari Lal. (6) Messrs. Volkart Bros. (7) Japan Cotton Trading Co. (8) Messrs. Toya Menka Kaisha, Ltd. (9) S. Jawala Singh, Buta Singh of Jaranwala. (10) Messrs. Volkart Bros. Sargodha. (11) Sh. Muhammad Ismail, Factory Owner, Sargodha. (12) Japan Cotton Trading Co. (13) Zamindara Trading Co., Sargodha and Bhalwal. (14) S. Chanchli Singh of Bhalwal. (15) Japan Cotton Trading Co., Baha-ud-din. (16) Messrs. Tata and Sons, Lyallpur. (17) L. Dhanpat Rai, Diwan Chand, Sargodha. (18) S. Kesar Singh, Lal Singh, Baha-ud-din. (19) Ganesh Cotton Co., Sargodha. (20) Messrs. Kirpa Ram, Birj Lal. (21) Messrs. Shiv Narain Harkaran Dass, Lyallpur.
1	...	...	...	...	...	...	2,300 0 0	13 11 0 to 14 6 0	6	2,300 0 0	2,300 0 0	
2	...	...	...	...	...	...	1,400 0 0	13 13 0	6	1,400 0 0	1,400 0 0	
3	2,513 30 11	16 13 6 to 17 1 0	2	...	...	...	...	...	...	6,038 38 13	6,562 0 0	
4	...	...	...	...	...	...	...	...	...	141 0 0	3,478 0 0	
5	...	...	...	215 0 0	19 15 0	3	...	...	...	4,173 0 0	4,173 0 0	
6	...	...	...	...	...	...	...	...	...	1,563 0 0	2,563 0 0	
7	...	...	...	240 2 8	22 8 0	1	294 8 12	16 0 0	1	1,137 17 10	1,155 20 0	

ANNEXURE VIII.

Statement showing sale in the Punjab of Improved Agricultural Implements during the year ending June 30th, 1923.

Imported implements.		Implements manufactured by the Punjab Agricultural Department.		Implements manufactured in India.	
Rajah ploughs ...	915*	Bar Harrows ...	218	Imitation Meston ploughs made in the Punjab and elsewhere in India.	1630
Meston ploughs ...	524	Drills ...	269		
Other ploughs ...	124†	Lyallpur Hoes ...	31		
Rajah Reapers ...	5	Drag Harrow ...	1		
Hoes	50	Miscellaneous articles	426		
Harrows	9			Shares for both ...	1,010
Simplex Fodder Cutters	46	Total ...	945		
Rajah Fodder Cutters	169			(a) Nahan and other Sugarcane Crushing Mills.	330
Shares for imported ploughs (all sorts).	373			Sardar ploughs (Bombay).	3
Hossier Drill ...	1				
Grinding Mill No. 2 ...	1			Kaisar-i-Hind Bullock Power Flour Mills.	2
Chatanooga Cane Mill	1				
Peg Toothed Harrows	7			Kirlaskar Chaff Cutter (Bombay).	1
Cultivators ...	7				
Other Fodder Cutters	5			Hathi Cane Crushing Mills by Burn & Co.	2
Bullock Gear Fodder Cutter.	3				
				Batala Cane Crushing Mills.	200
Total ...	2,240			Total ...	3,178

* 500 by Gurgaon District Board.

† 100 Chatanooga Ploughs.

(a) These were introduced quite independently of the Agricultural Department.

ANNEXURE IX.

Statement showing the purchase of wheat seed in Seed Depôts of the Punjab in 1923. *(up to 31st July 1923.)*

Name of Depôts.	Quantity.	Rate.	Cost.	Incidental charges.	Total cost.
		LYALLPUR.			
	Mds. Srs. Chs.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Jaranwala	148 22 8	4 3 3 to 5 11 0	716 6 3	...	716 6 3
Sangla Hill	293 20 0	4 6 6 to 5 8 0	1,662 13 6	...	1,662 13 6
Nankana Sahib	500 0 0	6 1 0	3,031 4 0	...	3,031 4 0
Toba Tek Singh	150 0 0	4 14 0 & 4 1 6	694 2 3	...	694 2 3
Tandlianwala	88 20 0	4 3 6	373 5 9	...	373 5 9
Samundari	120 0 0	4 2 0	495 0 0	...	495 0 0
Shahkote	140 0 0	4 2 0	577 8 0	...	577 8 0
Lyallpur	2,722 35 0	4 2 0 to 5 11 0	11,762 3 6	308 4 0	12,070 8 0
Total Lyallpur ...	4,163 17 8	... ...	19,312 11 3	308 4 6	19,620 15 9
		MONTGOMERY.			
Montgomery	4,417 20 0	4 4 0	18,774 6 0	674 3 3	19,448 9 3
Total Montgomery ...	4,417 20 0	...	18,774 6 0	674 3 3	19,448 9 3

ANNEXURE IX—CONCLUDED.

Statement showing the purchase of wheat seed in Seed Depôts of the Punjab in 1923 up to 31st July 1923—concluded.

Name of Depôts.	Quantity.	Rate.	Cost.	Incidental charges.	Total cost.
		HANSI.			
	Mds. Srs. Chts.	Rs. A. P. Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Hissar	921 20 0	3 14 0 to 4 0 0	3,663 3 3	..	3,663 3 3
Karnal	1,142 17 10	3 12 0 to 4 6 0	4,555 13 9	177 5 6	4,733 3 3
Rohtak	900 38 12	4 2 0 to 4 8 0	3,987 8 9	15 3 9	4,002 11 6
Total Hansi ...	2,964 36 6	... ...	12,206 9 9	192 8 3	12,399 2 0
		GURDASPUR.			
Jullundur	247 0 0	4 0 0 to 4 4 0	993 2 0	5 9 0	998 11 0
Hoshiarpur	210 0 0	3 13 0 to 3 14 0	802 8 0	57 0 0	859 8 0
Beas	90 0 0	4 0 0	360 0 0	14 1 0	374 1 0
Sialkot	189 10 0	4 0 0 to 4 12 0	861 0 0	...	861 0 0
Sargodha	1,637 30 0	4 0 0 to 4 12 0	7,166 15 0	806 1 0	7,973 0 0
Batala	34 2 0	3 5 3 to 3 13 0	120 0 0	...	120 0 0
Total Gurdaspur ...	2,458 2 0	... ...	10,303 9 0	882 11 0	11,186 4 0
		ABSTRACT.			
Lyallpur	4,163 17 8	... ...	19,312 11 3	308 4 6	19,620 15 9
Montgomery	4,417 20 0	... ...	18,774 6 0	674 3 3	19,448 9 3
Hansi	2,964 36 6	... ...	12,206 9 9	192 8 3	12,399 2 0
Gurdaspur	2,458 2 0	... ...	10,303 9 0	882 11 9	11,186 4 9
GRAND TOTAL ...	14,003 35 14	... ...	60,597 4 0	2,057 11 9	62,654 15 9

ANNEXURE X.

Consolidated Statement showing the purchases of Cotton Seed in Seed Depôts in the Punjab in 1923 *(up to 30th June* 1923).

Name of Depôt.	Quantity purchased.	Rate per maund.	Cost.	Incidental charges.	Total cost.
	Mds. Srs. Chs.	Rs. A. P. Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Sargodha	5,245 13 0 (including lint)	3 10 0 to 4 6 0 and Desi cotton (kapas) for seed at Rs. 16-4-0	21,844 10 6	4,455 1 9	26,299 12 3
Hansi Depôt	3,031 38 0	4 6 0 to 6 4 0	13,306 15 6	945 15 5	14,252 14 11
Lyallpur Depôt ...	4,066 38 0	3 4 0 to 4 8 0	17,426 8 0	897 8 3	18,324 0 3
Montgomery	4,361 31 0	3 3 6 to 4 0 0	15,836 8 6	565 1 9	16,401 10 8
Total ...	16,706 0 0	... ...	68,414 10 6	6,863 11 2	75,278 5 8

ANNEXURE No. XI.

Statement showing the income and expenditure of various demonstration farms in the Punjab during the year 1922-23.

Circle.	Name of farm.	Area.	Income.	Expenditure.	Profit.	Loss.	Remarks.
		Acres.	Rs.	Rs.	Rs.	Rs.	
Lyallpur.	(1) Rawind (District Board, Lahore.)	46	3,353	2,328	1,025	...	
	(2) Co-operative Demonstration farm, Chak No. 89-6-R.	25	702	133	569	...	
	(3) Co-operative Demonstration farm, Salarwala.	25	795	728	67	...	Recently started and most of the lands have been laid out.
	(4) Montgomery Demonstration and seed farm.	250	13,004	5,762	7,242	...	
Gurdaspur.	(5) Chililanwala seed farm.	250	12,764	4,883	7,881	...	
	(6) Gujrat District Board farm.	50	1,571	1,869	...	298	
	(7) Sardarpur farm (Private.)	50	1,472	604	868	...	
	(8) Jullundur District Board farm.	50 acres (30 acres waste or occupied by school)	1,895	1,593	302	...	
	(9) Sialkot District Board farm.	50	3,615	3,195	420	...	
	(10) Beas farm ...	43	1,434	2,456	...	1,022	
	(11) Khalsa College farm, Amritsar.	50 acres out of which 10 acres are under pits	4,097	3,547	550	...	
Hansi.	(12) Rohtak Demonstration farm.	40 acres	1,929	1,569	360	...	
	(13) Jallalabad ...	100	4,499	4,628	...	129	
	(14) Guru Har Sahai...	52 (15 under direct cultivation 37 under tenants).	2,202	2,031	171	...	

APPENDIX I.

Annual report of the Principal, Punjab Agricultural College, Lyallpur, for the year ending 30th June 1923.

Staff.—Mr. Milne officiated as Director of Agriculture from 3rd October 1922 to 18th December, in addition to his own duties, as Principal and Economic Botanist. He again proceeded to officiate as Director of Agriculture on 14th May 1923, when I took over charge from him as Principal, therefore I have officiated for one and a half months of the year under report.

Other changes necessitated among the staff have been as follows :—

(*a*) Bhai Kartar Singh, Agricultural Assistant, has been appointed 2nd Assistant Professor of Agriculture.

(*b*) L. Jai Chand, Assistant Professor of Botany, proceeded to Europe on long leave on 26th August 1922, afternoon, with a view to continuing his studies. Chaudhri Ali Mohammad, Agricultural Assistant, is officiating for Lala Jai Chand.

Consequent upon Mr. Milne's appointment as Officiating Director of Agriculture, Agha Yusaf Ali Khan, Assistant to Economic Botanist, was appointed to officiate as Economic Botanist incharge of the Research and outside work, from May 14th, 1923, and Lala Chuni Lal, Assistant Professor of Botany, as officiating 2nd Economic Botanist incharge of the Economic Botanist's teaching work in the College. M. Muhammad Hassan Khan, Agricultural Assistant, was appointed to officiate as Assistant to Economic Botanist.

(*c*) Lala Madan Mohan Lal, Assistant Professor of Entomology, has been on leave on Medical Certificate throughout the year. Bhai Hem Singh, Demonstrator, officiating for him up to 28th August 1922, afternoon.

(*d*) Bhai Hem Singh proceeded on leave to Europe on 29th August 1922 in order to continue his studies, Lala Harnam Dass relieving him and Lala Kesho Dass, Agricultural Assistant, acting as Demonstrator.

(*e*) The appointment of senior Assistant Professorship of English has been changed to Assistant Professorship of Agricultural Economics, Mr. Guleri continuing in charge.

(*f*) In the report of a year ago, it was mentioned that a Demonstrator in Botany had resigned owing to inadequacy of pay. The pay of this post is now similar to that of Demonstrators in Physics and Entomology. The vacant post of Demonstrator in Botany has been filled by M. Muhammad Afzal with effect from 30th July 1923. M. Muhammad Afzal obtained his B. Sc. degree in May of this year, securing the highest marks in his class and in addition constituting a record, in so far, that the marks are the highest ever obtained in the College.

(*g*) Mr. Guleri, Assistant Professor of Economics, has been in charge of the boarding-house, since the departure of Lala Jai Chand, Assistant Professor of Botany.

2.—*Results of the Examination of the English Course*—

(*a*) *B. Sc. (Agriculture)*.—Of twenty-four candidates who appeared for the B. Sc. (Agri.) Examination this year, eighteen have been declared successful, six have failed, but two of these have been placed under the compartment rule, *i.e.*, have to re-appear in one subject only.

(*b*) *First Examination in Agriculture*.—Twenty-seven candidates appeared in the first examination in Agriculture held at the end of the second year course. Of these, fourteen were declared successful, thirteen failed but of these four come under the compartment rule.

(*c*) *The two years' Leaving Certificate Course*.—This class consisted of twelve regular students and one casual student. Twelve have obtained the certificate and one has failed.

3. *Applications for admission to the English Course*.—About one hundred and eighty applications were received for admission to the main courses (degree and leaving certificate) given in the College. This number is considerably lower than last year, a probable reason for the decrease being that the results of the Matriculation Examination were very late in being announced, thus making it more difficult for people to decide whether they should apply for entrance.

The type of applicants was good and practically all selected for admission had passed the Matriculation Examination in the first or second division.

Fifty-three candidates were admitted.

The following is a classification of the students admitted :—

Source of application.	Number of students admitted.		
	Agriculturist.	Non-Agriculturist.	Total.
Ambala Division	6	...	6
Jullundur Division	7	3	10
Lahore Division	9	...	9
Multan Division	8	2	10
Rawalpindi Division	11	...	11
Delhi	1	...	1
Indian States	6	...	6
Other Provinces	...	...	...
Total ...	48	5	53

4. *Scholarships.*—(*a*) The Post-Graduate Research Scholarship of Rs. 900 a year was awarded to M. Bal Singh last year for special study in Fruit Culture. The scholar is receiving his training at present at Pusa. He has already been to Poona, where he worked for 7½ months under the Bombay Horticulturist and to Quetta, where he worked for one month and 23 days on the Fruit Experiment Station.

(*b*) The following scholarships awarded by District Boards, Indian States and other provinces, etc., are held by students of the College :—

District Board or other body.	No. of scholarships.	Value of scholarships.
		Rs.
Ambala	1	20 per mensem.
Pindi Gheb	1	12 „
Dera Ghazi Khan ...	1	15 „
Gujrat	2	20 „ each.
	2	15 „ each.
	1	10 „
Gurdaspur	1	10 „

District Board or other body.	No. of scholarships.	Value of scholarships.
		Rs.
Hoshiarpur	2	15 per mensem each.
	1	20 „
Hissar	1	15 „
Jullundur	3	15 „ each.
Jhang	3	12 „ each.
Lyallpur	3	15 „ each.
Lahore Muslim Kashmiri Conference.	1	10 „
Multan	1	15 „
Military scholarships ...	3	25 „ each.
	1	22 „
	2	20 „ each.
Rohtak	2	15 „ each.
Rohtak Jat Heroes High School.	1	20 „
Shahpur	1	25 „
	1	20 „
Sind	7	40 „ each.
Sheikhupura	1	15 „
Amritsar	1	10 „
Central Co-operative Bank, Roktak.	1	15 „

Our warmest thanks are due to these District Boards and other donors for their generous help to the students.

5. *Vernacular Class.*—During the year under report twenty four candidates took this short course, which is complete in six month- Six of the candidates were *ex*-soldiers, one was an employee of the Co-operative Department, the remaining seventeen being sons of Punjab farmers. All twenty-four students were successful in the examination held on completion of the course.

6. *Teachers' Class.*—With the object of spreading a general knowledge of Agriculture in Vernacular Middle Schools, teachers selected by the Inspectors of Schools, from the various divisions of the Punjab, are

sent to Lyallpur for one year's training in Agriculture. This year twelve senior vernacular certificated teachers took the course and were successful in the final examination. The report on the work of Agricultural teaching in Middle Schools, done during the past year, indicates that the training of teachers at Lyallpur has met a long felt want, and that their work in the schools is proving extremely popular.

7. *Rural Economy Class.*—The one month's Rural Economy Class, commenced on 20th February, and was attended by twenty members, comprising —

Three Assistant Commissioners.

Five Extra Assistant Commissioners.

Eight Zilladars, Irrigation Department.

Four Co-operative Department Inspectors.

The object of this Class is chiefly to give an insight to the work done by the various experts at Lyallpur, so that officers, who undergo the training, may be in a position to direct cultivators to the correct source of information with regard to any difficulties they may be in.

Many officers trained in this Class in the past have been of great help to the Agricultural Department when carrying out work in their jurisdiction.

8. *Improved Course in Agricultural Economics.*—The University having approved the changes, work has been started on the new courses. There is much scope for research in the subject, but very little can be done without additional staff.

9. *Popular Lectures.*—Four popular evening lectures were delivered at the College during the past year. These were open to the public and were well attended and much appreciated.

Sir Ganga Ram lectured on " Agriculture as a Profession ".

Captain St. Maur, A. R. D., lectured on " Horse-breeding in the Punjab ".

Mr. Smith, Imperial Dairy Expert, favoured us with two lectures on the following subjects:—

" Some common misconceptions in connection with Cattle-breeding in India ",

and

" Manufacture of Milk products in India ".

We are very much indebted to these lecturers.

10. *Medical Attendance.*—The temporary arrangements made for the residence of the Sub-Assistant Surgeon and the dispensary continue. The medical charge is sufficiently large to warrant the provision of a properly equipped dispensary, and it is hoped that the present handicap will be removed in the near future by the provision of the necessary buildings.

11. *Additional Staff in Botanical Section.*—The need for additional staff in the Botanical Section still continues and is now even more marked than it was a year ago. In addition to the time spent on the duties of Principal a great deal of Mr. Milne's time was taken up as Director of Agriculture, with the result that he was able to devote very little time to research work. The services of an Associate Professor are absolutely essential to look after the teaching work of the section and to carry out the instruction and guidance required by students taking the new M.Sc. course. Much valuable work already done in this section is likely to be lost unless adequate staff is provided in order to complete that work.

12. *The Tutorial System.*—The introduction of the Tutorial system, which the University Inspection Committee has been pressing for during the past three years, has not been possible owing to want of staff quarters on the estate.

As much supervision of students at games, etc., is given as is possible under existing circumstances, but the necessity for staff quarters and increased Hostel accommodation is very pressing.

13. *College water supply.*—That an epidemic of typhoid has not yet broken out says much for the vigilance of the staff generally and the Hostel Superintendent and Sub-Assistant Surgeon in particular. The present water supply for the College and the estate is wholly inadequate, apart from the real difficulty in obtaining the necessary water for drinking and cooking purposes, students have many times been caught bathing in water so insanitary as to be a positive danger to health. A tube well for an increased water supply was sunk four years ago and the completion of the scheme awaits electric power. As the then proposed electric installation for Lyallpur City has now been abandoned, it is essential that an installation for the College be completed without further delay, and I trust that this important matter will receive that careful consideration which it merits.

14. *Hostel Extension.*—Owing to shortage of accommodation in the Hostel, the College Rest-house continues in use for housing a number of the students. Some two years ago when many lakhs of bricks were collected on the College grounds for purposes of extension of laboratories, hostel, and for the construction of staff quarters, we thought that the end of the accommodation troubles was in sight. It is with great regret that I now observe the daily removal of these bricks, etc., and the consequent necessity of again pressing the claims of the College for very necessary extensions.

15. *Acknowledgments to staff.*—The Principal desires to acknowledge the loyal support he has received from the staff throughout the year. With their help good progress has been made in the work of the College, while an atmosphere, free from political influence, has been maintained.

T. A. MILLER BROWNLIE,

Offg. Principal,

Punjab Agricultural College, Lyallpur.

APPENDIX II.

Annual report of the Economic Botanist to Government, Punjab, for the year ending 30th June 1923.

Part 1.

Introductory.—I took over charge of the office of Economic Botanist from Mr. Milne on 14th May 1923 when he proceeded to officiate as Director of Agriculture, Punjab.

Cottons.

Cotton experiments were conducted as usual in two separate blocks. Varieties on small area were grown on 10-acre block composed of plots Nos. 11, 12, 17 and 18 of square Nos. 28 and 46, while varieties on large area were grown on 8-acre block consisting of plots Nos. 5, 6, 7 and 8 of square 31. The soil of these 18 acres is not very regular. Over 4 acres in square 31 are rather light and unsuited to cottons, while some patches in plots 11, 12, 17 and 18 of squares 28 and 46 are badly drained and rather hard for cotton plants.

Season.—Rainfall at Lyallpur during cotton growing and fruiting season of 1922-23 :—

Name of month.	Normal rainfall (average of 8 years) in inches.	Rainfall in 1922 (in inches).	Departure from normal (in inches).
July	3·59	1·47	—2·12
August	2·79	0·40	—2·39
September ...	1·75	0·23	—1·52
Total ...	8·13	2·10	—6·03

Owing to deficient rainfall in July to September, cotton season was hard during the growing and fruiting period. Dry southern winds prevailed for the greater part of August and early September. Most of the buds, flowers and bolls formed at this stage were dropped by Desi (Indian) cottons and by the early ripening American variety of cotton known as 285-F.

A very alarming situation was timely averted by September rains in Montgomery and Sargodha colonies. These rains affected improvement in Lyallpur weather conditions also, with the result that Desi and 285-F cottons bore a second crop along with 4-F, late in the season. Pickings were delayed about a month in each case, with the result that pickings were extended up to February in some cases. The months of December and January were warm and frostless otherwise such a late crop would have been completely ruined by the usual frosts beginning about the middle of December.

220 selections of both Desi and American cottons and over 840 crosses (chiefly of Desi cotton) were grown on smaller areas varying from a single line to 1/8 acre.

Copious supplies of irrigation water were given to these cottons with the result that in spite of dry weather both Desi and American varieties gave good yields this year.

Two varieties of American cotton (285-F and 289-F) and 4 varieties of Desi (G. Neglectum variety Roseum Nos. 124 and 132, G. Indicum variety Mollisoni Z and G. Sanguineum No. 27) were grown on half acre plots and gave very satisfactory yields, varying from about 10 to 15 maunds per acre. G. Sanguineum No. 27 gave the highest yield. This was 15 maunds 16 seers per acre while 285-F comes next with 15 maunds per acre.

Valuation.—Thirty samples of American and 11 samples of Desi cottons were sent to Messrs. Tata and Sons, Limited, Bombay, for valuation. Out of the American cotton samples, 4 cottons, *viz.*, 280-F, 289-F, 297-F and 289-F, spun 50s. and were classed with middling American and Uganda cotton and valued from Rs. 750-0-0 to Rs. 780 0-0 per Candy (784 lbs). Three other cottons, *viz.*, 285 F, 290-F, 296-F also spun 50s and were valued at Rs. 725-0-0. Five cottons, *viz.*, 72-F, 281-F, 292-F, 286-F, 287-F, spun 44s and were valued at Rs. 700-0-0. All other cottons excepting 4-F, 161-F, and 276-F spun 36s to 40s, and were valued from Rs. 640-0-0 to Rs. 690-0-0. 4-F, 161-F and 276-F spun 24s, 32s, and 34s, respectively and were valued from Rs. 625-0-0 to Rs. 640-0-0. Messrs. Tata and Sons, Limited, Bombay, say that "samples examined by us were superfine in class and as such would command a premium of about Rs. 40 over cotton of class fully good."

Out of 11 Desi cottons G. Sanguineum No. 27 tops the list. It can spin 14s, and was valued much above other Desi samples. It was valued at Rs. 535 (only Rs. 20 less than fine Broach). Other samples resembled fine Bengal and merit no special attention.

VALUATION BASIS.

	Rs.		Rs.
Fine Bengal	... 465	Fine Berar	... 495
Fine Broach	... 555	Cambodia	... 625
Surat	... 625	Navsari	... 650

American Middling Rs. 775.

Desi cottons as already mentioned fared badly this year. In case of farms where Desi cottons were not well supplied with water during September—October, the outturn on the whole was below normal, while in case of farms well supplied with water during these months, Desi cottons gave satisfactory yields. In greater part of Lower Jhelum and Lower Chenab Colonies, yields of Desi cottons as compared with American cottons were very unsatisfactory, varying between 3—5 maunds per

acre. They appear to have done better in Lower Bari Doab Canal colony but owing to higher premium offered for American cottons the profits per acre for Desis are as shown below unsatisfactory.

Statement showing outturns and profits obtained by growing Desi, 4-F. and 285-F. cottons on certain farms which reported on these points.

Name of cotton growing estate.	Variety of cotton.	Area in acres.	Outturn per acre.	Price obtained per maund (82 lbs.)	Gross income in Rupees.	Net profit over Desi.	Profit over Desi in terms of 100.
			Mds. srs.	Rs.		Rs.	
1. Oat hay Farm, Okara.	285 F	327	9 2	20	59,187	22,334	160·6
	4 F	327	8 20	18	50,031	13,178	135·7
	Desi	327	8 2	14	36,853	...	100·0
2. Col. Cole's Estate, Okara.	285 F	344	9 34	20	768	20,451	143·2
	4 F	344	10 0	18	61,920	14,603	130·9
	Desi	344	9 33	14	47,317	...	100·0
3. 15th Cavalry Farm, Lyallpur.	4 F	116	7 32	19	17,191	9,350	219·2
	Desi	116	5 8	13	7,841	...	100·0
4. 17th Cavalry Farm, Lyallpur.	4 F	45	5 8	19	4,446	1,053	131·0
	Desi	45	5 32	13	3,393	...	100·0
5. 16th Cavalry Farm, Sargodah.	4 F	125	7 0	18	15,750	7,156	183·2
	Desi	125	5 20	12/8	8,594	...	100·0

American cottons did much better than Desi cottons and no complaints regarding them were received from any part of the Province. Increased yields together with high premium over Desi cottons enormously increased the profits per unit area and enhanced the value of American cotton in public estimation. It is gratifying to note that through favourable results obtained this year, American cotton has re-established its superiority over Desi cotton and redeemed its credit lost through bad harvests of 1919—21. Area under American cotton has very considerably increased this year (1923).

Comparison between 285-F and 4-F.—285-F is an early ripening variety and has been shown to do better than 4-F under more trying conditions of water supply. Lower yields of 285-F than 4-F are mostly associated with thinner stand of 285-F in the field. This happens in the case of growers who are not well acquainted with this variety. The seed of this variety is much bigger than that of 4-F. The difference in the size of seeds of both varieties can be easily judged from the fact that :—

1,190 seeds of 285-F=1,316 seeds of 4-F=100 grams.

Most farmers without taking into consideration the size and weight of the seeds, thickness of seed coats, the presence or absence of fuzz, etc., on the seeds of different varieties, sow their cottons without any previous soaking in water (a process intended to give seeds a start to germinate) and at the usual seed rate of 10 lbs. per acre. A glance at the number of seeds per hundred grams weight, will show, that 10 lbs. of 4-F contain about 60,000 seeds, while 10 lbs. of 285-F have only 54,000 seeds. It has been observed that a well grown acre of 4-F cotton has 8,000 plants per acre, while that of 285-F has a little over 12,000 plants per acre, *i.e.*, 3 plants of 285-F for every 2 plants of 4-F. In other words 90,000 seeds of 285-F weighing 16½ lbs. approximately, should be sown for every 60,000 seeds of 4-F weighing 10 lbs. to the acre. In addition to this 285-F requires a more moist seed bed for germination than is required for 4-F, as fuzzy seeds take longer to get soaked and started. During April and May a comparatively dry seed bed may become too dry before the thicker fuzzy seeds have grown enough to appear above ground.

Lack of the above knowledge is usually responsible for a thinner stand and a lower yield of 285-F. Many intelligent growers have keenly studied all these differences however, and are annually getting higher yields and more money per acre by growing this variety.

285-F grown on 5,455 acres in the Lower Bari Doab Colony gave on the whole an average yield of 8 mds. 13 seers of kapas (unginned cotton) against an average yield of 8 mds. 32 seers of 4-F grown on 3,771 acres alongside of it. These were not the total areas grown in that colony but were the areas for which comparative figures were available. 285-F cotton was on an average sold at Rs. 20-0-0 per maund against Rs. 18-0-0 per maund of 4-F throughout this season. This gives a flat premium of Rs. 2-0-0 per maund in favour of 285-F cotton.

Profit per acre by growing 285-F against 4-F :—

	Rs.	A.	P.
8 maunds 13 seers of 285-F @ Rs. 20-0-0 per maund	166	8	0
8 maunds 32 seers of 4-F @ Rs. 18-0-0 per maund	158	6	0
∴ Net value of 285-F crop per acre over 4-F	8	2	0

Calculating profit on these 5,455 acres of 225-F @ Rs. 8-2-0 per acre we find that growers obtained a net profit of Rs. 44,321-14-0 over 4-F.

Reviewing the experience gained during the year under report it may be safely concluded that failure of American cotton to give satisfactory yield in 1921, was not due to any inherent defect in the variety of cotton or the soil it was grown on, but that abnormal conditions of weather and deficient water supply, were the main causes of failure. The fact that the Desi cotton scored over American in 1921 (a very abnormal year) caused very great apprehension regarding the future of Punjab American cotton in both trade and zamindari circles. Fortunately any one having suspicions on this point has been disillusioned by the success of American cotton this year.

While considering the success achieved by the cultivation of American cotton, it may not be out of place to sound a note of warning that a great danger in the form of deliberate mixing of American and Desi cotton before ginning, has of late appeared, and if this practice is not checked at the start, it is bound to ruin the cotton industry of this Province in a very short time. Unscrupulous middlemen in view of immediate profits have deliberately started mixing cottons before ginning on a large scale, and this I am sure will very soon lower the standard of the Punjab American cotton in the world's markets, and will reflect on the poor agriculturists in the form of reduced prices offered for their produce on one hand and the extinction of pure American cotton seed on the other.

Such practices will naturally stop paying if cot tons were sold by certified samples on the basis of blow room waste and spinning counts, etc., as suggested by the Economic Botanist to Government, Punjab, Lyallpur, in his evidence before the Indian Cotton Committee,—*vide* paragraph 1105, page 182, of "Minutes of Evidence," Volume I.

Wheats.—The season on the whole has been very adverse for all rabi crops in general and for wheats in particular. Summer rains preceding wheat crop were very poor. Winter however was very wet and from December onwards the season continued to remain wet throughout the whole of rabi season.

Rust made its appearance unusually early in the middle of December this year and multiplied with unprecedented rapidity.

A severe hailstorm overtook wheats on 7th March and worked great havoc in early ripening varieties. Late ripening wheats could by no means escape the injury but as most of them had not flowered by that time the damage in their case was not so serious. In some plots over 30 per cent heads of early ripening wheats were completely knocked off the plants.

The most unfortunate occurrence of the season was the abnormal rains during harvest. Wheat threshing had just begun when rains started and from May 13th to 24th, 3·19" of rain fell at Lyallpur. These untimely rains seriously interfered with threshing opera-

tions and spoiled wheats on the threshing floor and stacks to a very serious extent.

Weather prevailing at Lyallpur during wheat growing season.

Months.	Number of rainy days.	Normal number of rainy days.	Rainfall in inches.	Normal rainfall in inches.	Cloud amount.	Normal cloud amount.	Average Humidity.	Normal Humidity.	Dates of irrigation.	REMARKS.
December 1922.	2	0·7	0·65	0·35	4·9	3·6	86·64	80	9th December 1922.	
January 1923.	4	0·7	0·64	0·38	5·4	3·9	87·44	84	...	
February 1923.	6	1·1	1·05	0·31	7·5	4·4	86·21	77	6th February 1923.	
March 1923.	4	2·3	0·67	0·80	5·4	4·1	69·38	68	22nd March 1923.	

A look at the above table shows that the months of January and February were very humid and cloudy. Maximum temperatures remained low but minimums rose higher than usual and with this low diurnal range, high humidity and cloudy weather, very favourable conditions for fungus development were produced. Comparing the weight of 1,000 grains of wheat produced in 1923 with those of 1920 (a healthy year) we find that the growers of 8-A (a moderately rust resistant and heavy yielding variety) have lost 14·8 per cent in weight through rust this year.

Rust was responsible for shrivelling of grains and decreased yields of wheat at Lyallpur and many other parts of the Province. Attack of rust was universal this year and if the above rate of damage is extended to other affected areas, the amount of loss to the Province would rise to a very high figure indeed. Over 1,000 sowings of wheat were under observation and with the exception of 5 crosses, *viz.*, Nos. 1, 101, 104, 105, 106, 107, 109, and 121 all were badly attacked by rust. The behaviour of these crosses will be critically watched in future. Eighteen acres of experimental wheats were grown. Of these 10 acres, were grown in plots 20, 21, 22 and 23, Square No. 46 and 8 acres in plots 9, 10, 11, and 12, Square No. 31. Yields have been so adversely affected by the various calamities mentioned above that much reliance cannot be placed on outturn figures obtained on small areas this year.

The following types of wheat, *viz.*, 8-A, 8-B, 9-C, 16-A, 17-B, Cross 2, Cross 3 and Pusa-12 were tested against Punjab-11 in alternating plots on 1/8 acre in two sets. One set was sown on 2nd November 1922 and the other on the 17th November 1922. The net result of the experiment

is that 8-A beats Punjab-11 by 3 mds. 7 srs. grain and 11¼ mds. straw, while Punjab-11 beats all others and stands 2nd in the list.

Of all wheats under trial 8-A has again topped the list at Lyallpur, Sargodha, Hansi and Gurdaspur this year. At Lyallpur it was tried against Punjab-11 on the agricultural farm and tenant's area, and has consistently given higher yield than Punjab-11.

At Hansi it was tried against Punjab-14 and of all wheats 8-A has given highest yields.

At Gurdaspur 8-A was tried against Pusa-12, Pusa-4, Punjab-17, Punjab-14, Punjab-13, Cross 3 and 16-A and has topped the list in both irrigated and unirrigated areas.

A study of the root-system of different wheats was made last winter. It was found that wadanak wheats (Triticum Durum) are the most shallow rooted and this appears to be the main cause of their failing to do well at Lyallpur and other places where water-level is very low. These wheats always do well in localities having higher water level and more particularly so in wet years like the one under report. 8-A was found to possess deeper root-system than Punjab-14 (a celebrated barani wheat) and this appears to be the reason why 8-A has regularly beaten Punjab-14 on barani (unirrigated) areas during the past seven years (*vide* reports of Deputy Director of Agriculture, Gurdaspur, for the years 1916—1923).

Grams.—Twenty-six Punjab types of grams were as usual tried on $\frac{1}{3\frac{1}{2}}$ acre in plot $\frac{25}{46}$. The yields are on the whole poor, varying from 8 to 12 maunds. The abnormal season caused by the continuous rains at the flowering and fruiting period is the chief factor in lowering the yields in Lower Chenab Canal Colony and many other parts of the Province this year.

Barleys.—Twenty-six Punjab types of barleys, one cross and two English barleys were grown on $\frac{1}{3\frac{1}{2}}$ acres each in Plot No. $\frac{24}{46}$ this year. Lyallpur B. S. was used as a standard and was grown after every 11 sub-plots to check the differences in the fertility of the soil.

To start with, the crop came up very well but a very serious calamity in the form of a hailstorm overtook it on 7th March 1923. The grain in most of the early varieties had set and was in milky stage, while flowers in late varieties were setting at this time. This hailstorm worked great havoc and actually spoiled over 40 per cent of the heads in barley varieties. As this crop had passed its flowering time therefore it could not make up the loss sustained by producing new shoots later. Barley outturns this year have therefore been lower than anticipated and have been varying between 16 to 20 maunds per acre.

Barley types Nos. 1, 2, 4 and 5 were grown at Hansi on ¼ acre plots this year. Types Nos. 1, 4 and 5 have beaten local barley by 4¼ to 4¾ maunds and No. 2 by 1¼ maund per acre.

Oats.—Nine varieties of oats were grown as usual on $\frac{1}{3\frac{1}{2}}$ acre each. On account of a cooler spring, Scotch and French varieties gave a higher yield of grain this year than usual. Demand for oats as a late

Rabi fodder is springing up and over 120 lbs. of Scotch oats were imported and distributed amongst farmers this year.

Potato Experiments in Simla Hills.

Six Scotch potato varieties, *viz.*, Nos. 3, 6, 11, 17, 18 and 19 were grown interstripped with the local variety in different fields. Twenty-one newly bred varieties were also grown on very small plots.

We had altogether an area of over 4 acres under these experiments. They consisted of a number of fields in the following localities in the Simla Hills :—

(1) Bogna and Pataingli near Mashobra.
(2) Kufri.
(3) Haroge and Meloge near Kufri.
(4) Domahr and Gudharb near Fagu.
(5) Kaintari near Solon.

On account of the abnormally heavy rains in the hills during the ripening period of potato crop, a lot of tubers got rotten in the ground before digging out the crop. The loss on this account was greatest in the clayey lands, particularly those situated at high altitudes. In most of these cases the growers of Desi potatoes have not been able to harvest an amount of tubers equivalent to the amount of seed tubers planted by them. The crop has however suffered comparatively much less at low altitudes particularly where grown in shaley sort of land. This is in accordance with what we have experienced in the past years.

In spite of bad weather Scotch potatoes have on an average given 41½ maunds of tubers per acre in excess of local variety. Calculating at the current market rate of Rs. 4/4 per maund, the growers of Scotch potatoes had a net gain of Rs. 177/-/- per acre over local potatoes.

Date Farm, Muzaffargarh.—There was very little rain, hardly 1 inch, during the months of July and August 1922 at Muzaffargarh. The season being dry, a heavy crop of excellent date fruits was matured. Over 30 maunds of cured date fruits of which nearly 15 maunds were of good quality, were cured last year. Special, 1st and 2nd class qualities of date fruits were packed in 1 lb cartons and offered for sale @ Re. 0-10-0, 0-8-0 and 0-6-0, per lb, respectively. Third class fruits were sold in bulk at about 2 annas per lb. A few advertisements attracted customers from the whole of Northern India and orders far exceeded the supply in hand. These included many repeat orders from satisfied customers which show their appreciation of the quality and value offered for the money. In view of the past year's experience I am sure there is room for disposal of any quantity of superior quality dates. The tube well on this farm is working satisfactorily and from October 1922, date farm has been supplying irrigation water to Taleri garden. The date farm has given a profit of Rs. 69-4-10 this year and there is every hope of its increase with the increase in the age of the trees and the area under them. The pays of the B. Division Agricultural Assistant and a special date mali stationed there are not included as they are making records, observations and experiments for the benefit of the date palm industry which would not be made on an ordinary date farm ; also they have date palm duties in other districts.

Statement showing the income and expenditure of the Model Date Farm.

MUZAFFARGARH.

No. of Item.	Income.	Amount.	No. of Item.	Expenditure.	Amount.
		Rs. A. P.			Rs. A. P.
	Sale proceeds of—				
1	Arabian Date fruits	949 2 6	1	Labour—	
2	Desi Date fruits	40 0 0		Malis	514 9 9
3	Wheat Grain	369 9 0		Engine Driver	352 0 0
4	Wheat Bhusa	140 0 0		Chaukidar	60 8 4
5	Green fodder	140 0 0	2	Cost of one bullock	80 0 0
6	Empty oil tins	43 5 0	3	Feeding charges of one pair of bullocks ...	82 2 4
7	Nursery	22 12 0	4	Kerosine oil for engine	158 7 9
8	Date Suckers	59 0 0	5	Contingencies	699 3 6
9	Tobacco	12 8 0			
10	For supply of Irrigation water, etc, to Taleri Garden from 1st October to 31st March.	240 0 0		Total ...	1,946 15 8
	Total ...	2,016 4 6		Net profit	69 4 10

XV

Wheat earcockle.—Panipat Tahsil of Karnal District was found badly infested with earcockle, and with the help of Deputy Director of Agriculture, Hansi, three demonstration plots at Gharaunda, Panipat, and Samalkha were sown this year. The results in each case distinctly proved the advantages of sowing clean seed. Along with the practical education imparted by demonstration plots etc., distribution of clean seed (8-A for the most) is being vigorously pushed by the Deputy Director of Agriculture, Hansi, and I hope this area will soon be cleared of this disease.

Red Rot on Sugarcane.—In addition to Ferozepore, work on sugarcane red rot was extended to Dharamkot. Repeated demonstrations have created a keen demand for disease-free seed now. After a great deal of search, village Muazim near Fazilka was found apparently free of the disease and Muazam seed canes were supplied to growers by the Deputy Director of Agriculture, Hansi, this year for 8 acres at Dharamkot and for 4 acres at Ferozepore.

Staff.—The staff of the section worked well and gave hearty assistance during this year. I wish specially however, to mention Bhai Rattan Singh, L. Ag., who in spite of Bhai Harnam Singh's sudden illness at harvest very cheerfully managed the whole of the wheat harvest this year.

YUSAF ALI KHAN,

Officiating Economic Botanist to Government, Punjab,
Lyallpur.

APPENDIX III.

Annual Report of the Agricultural Chemist to Government, Punjab, Lyallpur, for the year ending 30th June 1923.

Staff.—S. Arjan Singh left the Chemical Section on 25th September 1922, on his promotion as Extra Assistant Director of Agriculture. On 12th December 1922 he took charge of the Bara Farm from S. Gurdial Singh on the latter's transfer to Sargodha.

M. Barkat Ali proceeded on sick leave on 9th August 1922, and remained away during the whole year.

L. Girdhari Lal who was appointed to fill the temporary vacancy caused by S. Arjan Singh's transfer, on 11th December 1923, exchanged his post with S. Sher Singh, M. Sc., Demonstrator.

Mr. S. M. Nasir returned from England after one year's study leave on 22nd December 1922, and took charge of his duties in the Bacteriological Laboratory.

S. Balwant Singh, B. Ag., was appointed on 17th August 1922 to fill the temporary vacancy caused by Dr. Ramji Narain proceeding on 2½ months' privilege leave, and has since been retained to fill the vacancies caused by different members of the staff going on leave.

S. Balwant Singh, B. Sc., went on 9 months' leave on 7th October 1922 and returned on 31st May 1923, after passing the M.Sc. Examination.

2. In presenting my report for this year, I divide up the work of the section into two main parts—the *General Routine work* and *the Investigations or Research work*, a summary of which is given in the following paragraphs. Some of the latter has been going on for some years, and when sufficient data has been accomplished in order that more logical conclusion may be drawn the results are being published. One Bulletin has recently been published by the Department of Agriculture for India, on the work on Green Manuring which has been in progress for the last five years, and a paper on *Animal Nutrition* work which has been in progress for the last two years has just been prepared for publication.

3. *Provincial Routine work.*—An abstract of the routine work undertaken for private individuals and other departments is given below :—

	No. of Samples analysed.
Soil	109
Sugar-cane and Gur	98
Waters	13
Lime	7
Manure	11
Sugar beet	7
Miscellaneous	11
	256

Besides this 876 individual samples were analysed in connection with chemical investigations going on in the Laboratory and which will be detailed under the respective headings.

4. *Local Soil Survey.*—During the year three investigations on Kallar and waterlogged soils have been conducted and reports submitted, *viz* :—

(*a*) On the Jalalpur canal area in which the progress of Kallar deterioration of the lands is reported.

(*b*) On the waterlogged lands in the Sargodha District caused by seepage from Lower Jhelum Canal.

(*c*) On the waterlogged land in the Chakanwali area, District Gujranwala.

In each case of waterlogging investigated the cause is seepage from the canal with consequent rise of salt to the surface, which condition, if seepage is not checked may in course of time become very pronounced.

The remedy is (*a*) to drain the land (*b*) to prevent further seepage occurring as far as possible by properly constructed drains and (*c*) to wash out the accumulated salts by heavy irrigation, assisted by cultivation. Full details are given in part II of the report.

RESEARCH.

Bara Farm.

5. In presenting my report on the progress of Reclamation at Bara Farm it is regretted that no definite opinion can yet be given as to the prospects of ultimate reclamation. Full details of the year's work are given in part II and the best indication of the progress so far attained may perhaps be gleaned by a glance at the maximum yields from the cane and wheat areas after treatment. The maximum yield of Gur obtained per acre is 4 maunds 30 seers which is roughly 10 per cent. of that obtained on good normal land; whereas on the wheat areas the maximum yield was 5 maunds 18 seers which is about 16 to 20 per cent. yielded by normal land.

These figures compare very favourably with yields obtained on untreated land the maximum yield from which is 36 seers of Gur on cane land and 3 maunds of wheat on wheat land.

In judging the results of the 5 years working of the farm to date the fact must not be lost sight of that the particular physical condition of this land as seen to day is the result of the accumulated, climatic and other effects brought about during the course of hundreds of years, and it is hardly to be expected that a reversal of these conditions can be brought about in a very short time. The effect of treatment and heavy cultivation is to accelerate the reverse process and only an elementary knowledge of science is required to indicate that time and weathering are most important considerations to be borne in mind.

Every endeavour is being made to keep the land opened up by Engine cultivation, by the addition of manures and green organic matter, which will assist in breaking up the hard clods, and by irriga-

tion, which also facilitates the washing down of the salts. There is no doubt whatever that the only way to tackle Bara land is by the aid of heavy steam cultivation, bullock power being too feeble.

It has been decided that in the near future a committee of management be formed to conduct the general lines of work at this farm and that the direct control of the Agricultural Tackle and operations shall be entrusted to an Agriculturist specially qualified to deal with steam implements.

It is hoped that new or more intensive methods of utilising the heavy engines at Bara Farm may perhaps accelerate the process of reclamation, but at this transition stage it is necessary to take very careful stock of all the pioneer work which has been so far carried out under the directions of the Chemical Section from the time the land was in the condition of a hard rock and grew nothing, to date when the most that we can say is that most decided advances have been made and that the produce obtained from "Treated Bara Land" represents quite good crops, compared with that from virgin, Bara land, though very far from approximating to normal crops, or from producing an Economic return.

We may be at such a stage now when a great acceleration of the reverse process mentioned may be looked for with continued cultivation, on the other hand few more year's work may produce but a feeble acceleration. Reference to the figures given in part II will show that at a depth of 11 feet even, the Bara soil contains 30 times as much water soluble matter as normal soil, and the important problem further confronts us of washing down this soluble matter which is complicated by the impervious nature of the soil.

Another year or two should enable an opinion to be passed as to whether reclamation can be expected within a reasonable length of time and whether the results will justify the means. Even then the matter will not be ended as it will still remain to be seen whether, unless intensive methods of cultivation are continuously employed a reversal to Bara conditions may not occur.

The Agricultural Adviser to the Government of India who visited the Farm in March was optimistic in his opinion and was confident that revised methods of cultivation with the steam tackle should accelerate results.

The Experimental Sullage Farm.

6. In presenting my report on this Farm, I wish to commence with a retrospective view from the date of its commencement at the end of the year 1917, bearing in mind the nature of the land comprising the Farm, the results obtained to date, and the prospects which these hold out of obtaining data for which the experiment was designed, *viz.*, the optimum concentrations of Sullage water to be applied to crops. In the original description of the land by my predecessor the following sentences occur. —"Unfortunately the fertility of the land is so uneven that it has not been possible to commence the experiments designed," and that "That three crops have been

grown on the land with the object of exhausting as far as possible the soil" (Annual Report 1918-19.)

The work has now been carried on for 5 years and although a considerable amount of data has been accumulated we are still far from being in a position to present any definite conclusions. In the first place this piece of land should never have been chosen as it is of so obviously uneven a nature, which of necessity invalidates conclusions drawn from plots and their controls.

The fertility contours originally plotted are of an empirical nature based on the results of 3 crops, and the contention that the land can be exhausted as a rasult of growing these crops cannot be accepted as true. The experiments were thus started and continued on a piece of land too small and of far too uneven a nature, in my opinion to justify itself or to enable accurately scientific data to be obtained. In presenting the details of the results obtained this last year, it is as well therefore not to make any undue claims. Such an experiment required to be carried out on a very large area of even nature where controls and experimental plots may be taken on a common level of fertility and where a large number of control and duplicate plots are available.

The experiment has, however been carried on taking into account the irregularities of fertility as revealed by the contour lines, the results from the various plots being brought to a common level basis as far as possible by the use of the fertility factors obtained.

Another difficulty of fundamental moment is the variation from day to day in the concentration and nitrogen content of the sullage water used. In accepting sullage from a town of say 30,000 inhabitants such as Lyallpur, fluctuations are great and during one irrigation the full sullage water may even be weaker than the 50 per cent. sullage used in a previous irrigation. In order to endeavour to balance these irregularities the sullage water applied was always analysed, and due account taken of the total nitrogen applied to the various plots. So far the general results indicate that full sullage as obtained from the city is most beneficial for fodder crops such as maize which receive only about 3 irrigations during its course of growth. In the case of vegetables of which Cauliflower, Spinach, Carrots, Radishes and Turnips were tried, Cauliflower and Spinach did very well with full sullage water but it was somewhat injurious to Carrots and Turnips producing a bitter taste with considerable rotting and bursting; the 50 per cent. sullage being most beneficial.

Full data are given in Part II. It is instructive to note from the curves that during the period of about one month the total nitrogen in the soil varies within the limits of 1,275 and 675 lbs. per acre in the case of plots to which 25 per cent. sullage water was given, whereas the maximum amount of total nitrogen added in three sullage irrigations was only 45.5 lbs. per acre (calculated). Thus the fluctuations in the nitrogen content of soil bring in a most complicating factor when endeavouring to interpret results in terms of total nitrogen added in sullage water.

Nitrogen Fixation.

7. This work was carried on on lines similar to those followed during previous years, with the only difference that the amount of Nitrogen added to or lost from the soil owing to natural causes was estimated from month to month. A very large amount of fixation amounting from 75% to 110% over the figures for the previous month has been noticed in a number of cases, while corresponding denitrification figures although not so high are equally striking, varying from 25% to 54%. In this connection it is noteworthy that on the sullage farm the variation noticed in the amount of nitrogen originally in the soil is from 1,300 lbs. per acre in one month to 650 in the next. It is evident from a consideration of these figures that the soil fixes a very large amount of nitrogen rapidly but loses it equally rapidly and it is difficult to make use of the nitrogen fixed in this manner for the crops except under the natural conditions of plant growth of whose complicated nature we have but little know ledge. The detailed results obtained are given in part II of the report.

Manurial Experiments at Gurdaspur.

8. *(a) The effect of different manures.*—These were tested on the sugarcane. It has been found that Ammonium Sulphate applied at the rate of 350 lbs. per acre gives the best economic yield. It not only improves the quality of the cane, but increases the outturn of cane per acre as well. Of all the manures tried (*a*) Ammonium Sulphate, (*b*) Super-phosphate (*c*) Lime and (*d*) complete manure, *i.e.*, a mixture of (*a*) and (*b*), along with Potassium Sulphate, Ammonium Sulphate alone has been found to be capable of bringing any excess profit to the Zamindar. In this case this excess profit comes to about Rs. 50-0-0 per acre. Complete manure which gives second best results both in the laboratory and the fields, owing to its high cost is the most uneconomical to use, resulting in lowering the income by Rs. 54-0-0 below control per acre. The results of the coming year's trials are expected to throw more definite light on these conclusions.

Besides these a number of sugarcane samples were analysed, the object being the selection of varieties of sugarcane with a high sucrose content, as also to find out the maturity period of different varieties of cane grown at Gurdaspur. The details of these experiments are given in part II of the report.

(b) On the effect of Super-phosphate on wheat in chahi area.—Super-phosphate was tried alone as well as in connection with (*a*) Farm yard manure, and (*b*) Green manure. The result obtained this year lead to the following conclusion :—

(1) Farmyard manure gives more uniform results than green manure;

(2) Super-phosphate in conjunction with farmyard gives better yields than with green manure; and

(3) Super-phosphate alone is not of much use.

(*c*) *Artificial Manures alone and in conjunction with Green manure on Barani Wheat Area.*—It is unfortunate that the results of

the experiments this year were spoiled by rain and severe wind storms. The figures, nevertheless, are given in part II.

(*d*) *Green manuring experiments.—The residual effect of Bhang buried in 1920-21.*—It has been found that the effects of green manure still persist even after the fourth year. The actual results however are not reliable owing to the bundles (after harvesting) of wheat from different plots getting mixed up with each other and being carried away by winds.

MANURIAL EXPERIMENT AT LYALLPUR.

9. *Green manuring experiments.*—This is the 5th year of the experiment. The green manure was applied for the first time in 1917. Since then only the residual effect of the manure is being studied. The results of the last year's experiments confirm those of the previous year, *i.e*, the application of green manure to a sandy soil is more paying. While during the fifth year, the residual effect of the green manure in a sandy soil is quite marked, showing an increase of 19·35, 12·90 and 35·25 per cent. with guara one, two and three doses repectively; the residual effect has disappeared entirely in stiff soil where we are getting less yield than are given by the control plots, with all three different doses of green manure.

ROAD EARTH.

10. In view of the impending Colonisation of the Nili Bar, I was requested during the year by the Road Engineer to find out if possible the chemical and mechanical constituents of soils which would constitute a good road earth. For this purpose a large number of soil samples representatives of each district in the Punjab from Kachcha roads known to possess good wearing qualities were collected and analysed. For comparison a number of samples from roads of poor quality were also analysed. The result obtained indicated that the chemical and mechanical constituents of earth, as revealed by analysis do not within certain wide variations necessarily indicate the capacity of the soil in question to form a good binding road earth. The climatic conditions and the nature and amount of wheeled traffic will have a great effect in influencing the binding power.

WHEAT DUST.

11. Wheat dust contains enough manurial constituents to justify its use as a manure. The nitrogen in it is not, however, in a readily available form. At the instance of the Minister of Agriculture, a number of fermentation experiments were conducted to find out the best conditions and time for complete fermentation. It has been found that when kept in a heap in the open covered with soil, during the first 7 weeks, the percentage of proteins goes on falling, from 1·598 per cent. to 1·033 per cent. when it remained almost constant throughout the period of the experiment, *i.e.*, about 14 weeks. The amount of ammonia produced and retained in the heap also runs parallel with the above change, increasing up to the 8th week, and becoming constant thereafter, and finally decreasing rapidly during the last two weeks of the experiment. It is expected that further fermentation will result in breaking down a larger percentage of proteins than has been done hitherto.

12. Detection of small quantities of Phosphates in soil. While carrying out a number of analyses of the Gurdaspur farm soils to which 350 lbs, of super-phosphate per acre has been added very ambiguous results were obtained for $P_2 O_5$ (Phosphorous pentoxide), which in many cases gave figures lower than those corresponding to the above amount of super-phosphate. This lead me to investigate with closer scrutiny our methods for the estimation of phosphates. As a result of a number of analyses it has been found that it is not possible to detect, with the present method of estimating $P_2 O_5$ an amount of phosphorous corresponding to 350 lbs. of super-phosphate per acre of soil. The amount of $P_2 O_5$ which actually comes to be estimated in the laboratory is too small and even a very small experimental error vitiates the accuracy of the results.

Digestibility Trials.

13. During the past two years digestibility trials have been conducted with a view to determining the digestibility co-efficients of certain animal fodders : Bhusa, Maize, Gram and Shesham leaves. The results of these are being sent for publication in the Journal of Agriculture in India, and the work is being continued and extended. It is not therefore proposed to present the details of the work in the annual report. This is a most important line of investigation and very little has hitherto been done on it in India.

Wheats and Oats Growing.

14. *Investigation on variations in Nutrient Constituents of growing Wheats and Oats.*—It is the practice both in this country and some other countries to utilize wheat and oats in the green conditions for feeding to other animals, and it was considered to be of interest to determine at what stage of growth the maximum yield of digestible food constituents might be obtained. Analyses were commenced at the middle of March, when in the case of wheat the young ears were just making their appearance and on the same date with the oats, whose ears had hardly yet appeared.

The data so far obtained does not permit of definite conclusions being drawn and it is proposed to continue the work in the coming wheat season on a more comprehensive scale in order to throw further light on this question.

15. Bacteriological.

(1) *Reclamation of Bara Soils of Lower Bari Doab Colony.*—Mr. Nasir while in England did some work on these soils. He has indicated the possibility of reclamation if alkali salts are washed out of the soils after they have been treated with gypsum.

Experimental details are published in Bulletin No. 145 (1923) of the Agricultural Research Institute, Pusa.

(2) *Investigations on soil Protozoa.—A. Nitrogen Fixation.*—Mr. Nasir has published a paper in the annals of Applied Biology, Volume X. No. 1 (1923) on the "Relationship of Protozoa to soil Fertility with special reference to Nitrogen Fixation". He has shown that contrary to the views of Russell and Hutchinson (Jour.,

Agric, Scie. III 1909; also V. 1913) the presence of protozoa is beneficial to the process of non-symbiotic fixation by Azotobacter.

Further experiments are in progress to discover the factors involved in Symbiotic relationship of protozoa and Azotobacter.

Up to this time attempts have not been successful in obtaining bacteria free cultures of protozoa.

B.—Concentration of media.—Elaborate series of experiments to find out a suitable media that will present ideal conditions for protozoal growth are in progress in the laboratory.

C.—Reaction of media—This experiment was in continuation of the work already done at the Rothamsted Protozaological laboratory.

These experiments have shown that protozoa can grow in much higher ranges of acids and alkali concentration than have been hitherto found.

A modification has also been made in Thornton's Synthetic media (Ann. App. Biol. IX, 1922) which now gives all points between 3 and 10 P. H.

The results are being compiled in the form of a paper which will soon be ready for publication.

D.—Protozoon Population of Lyallpur Soils.—During the hot months all the three types of protozoa are present in Lyallpur soils.

Ciliates and Amoebae are more abundant and grow on Nitrogen free media in preference to other media containing nitrogen compound.

Attempts are being made to identify the species but the literature at present in the College library is very inadequate for this class of work.

For an advanced type of research it is of great importance to have up-to date literature ready at hand but the present unfortunate conditions of financial stringency do not however permit to make any additions to the existing literature.

P. E. LANDER,

Agricultural Chemist to Govt., Punjab, Lyallpur.

APPENDIX IV.

Annual Report of the Entomologist to Government, Punjab, Lyallpur, for the year ending 30th June 1923.

PART I.

I.—General.

Position of Entomology.—In so far as agricultural industry is concerned India can only be compared with the United States of America. And what position does Entomolgy occupy in the agriculture of that country? It is recognised there as one of the premier sciences connected with agriculture. Hundreds of entomologists are engaged on the study of plant pests. In the Punjab, on the other hand, Entomology is considered as of the least importance and its position in respect to staff quarters for the staff, laboratory accommodation, standard in the college curriculum, etc., etc., is the very lowest. It was the Punjab that suffered in a single bad bollworm year, a loss of 2-3 crores of rupees. The damage done to the crops in the Punjab by pests and vermine would run to tens of crores of rupees annually. Is Entomology then of no importance in the economic uplift of the province?

All the demands of the Entomological Section are still 'in the air' and they include an insectory, an Assistant to the Entomologist, 4 Agricultural Assistants for District work, 4 Agricultural Assistants for Research and Sericulture Establishment.

Research.—Teaching, "scouting, research, field operations" and propaganda constitute the work of the Entomological section. Very often the work of an officer combines several of these duties. I have already pointed out that this inharmonious combination is very discouraging to the workers and tends to lower the standard of research and make other Entomological work equally impossible. It must be admitted that research which demands undivided attention and prolonged concentration cannot be combined with the work of a "scout" or district officer. In the interest of teaching and research it is imperative that "scouting," 'field operations'" and "propaganda" be conducted by those members of the staff not engaged on research and teaching. In spite of this handicap the following original papers dealing with the work done in this section were contributed to the Fifth Entomological Meeting held at Pusa during February 1923:—

1. Some parasites of the Cotton Bollworms *Earias insulana* Boisd. and *E. fabia Stol.* in the Punjab.
2. Colour variations in *Earias insulana* Boisd. in the Punjab.
3. A Preliminary list of the parasites of Economic Importance bred in the Punjab.
4. Life history of *Tetrastichus radiatus*, Waterston, parasites on *Euphalerus citri* Knw. and its hyper-parasites.

5. Rat destruction on field scale.

6. Air tight storage of grain.

7. Life history of *Idiocerus atkinsoni*, Leth.

Propaganda and Demonstration.—Entomological Exhibitions were held at the following places :—

Delhi, Jullundur, Palwal, Okara, Hoshiarpur, Sargodha and Chôa Saidan Shah.

Lectures illustrated with lantern slides were delivered on the following occasions :—

1. Annual gathering of Chenab Colony Club at Lyallpur on "Field rats and how to control them."

2. Co-operative Conference at Gujranwala on "Crop pest."

3. Co-operative Conference at Sialkote on "Rats and their control."

4. Annual meeting of S. P. S. K., Lahore on "Field Rats and their control."

Field operations.—It is unfortunate that restrictions on travelling are imposed at a time when Entomological work has begun to extend. The general drift towards economy has forced the railway administration to withdraw concessions given to the Agricultural Department for carriage of implements such as Spraying machines. Further, a centralised Entomological staff is unable to carry on successful warfare against pests. Insects multiply with such marvellous rapidity and the damage done by them is so sudden and sweeping that unless immediate steps are taken nothing can be saved. Blight is like fire and prompt action must be taken against its attacks. For field work it is essential that a man be on the spot prepared to take action at the first sign of appearance of pest. In fact in countries where importance of insects is recognised, precautionery measures are taken before the insect has even appeared. At my suggestion, the Director of Agriculture, Punjab, Lahore, transferred Chaudhri Sultan Ali, Agricultural Assistant, trained in the Entomological Section, to the Agricultural Farm at Gurdaspur, to be incharge of Entomological work in addition to his own duties as Agricultural Assistant. I am glad to say that Chaudhri Sultan Ali has already proved his worth. Soon after taking over charge of his work he checked a serious attack of *Pyrilla* on maize by such simple and handy process as "bagging", and within a few hours collected insects weighing 5 pounds. He thus not only saved the maize crop but also the sugarcane on which this insect must have gone if allowed to breed unchecked. At least one Agricultural Assistant—sufficiently trained in Entomology to be able to carry cut remedial measures—should be stationed at each Agricultural Farm, and all Farm Managers should be similary trained. No farmer can achieve success in his profession unless he can effectively save his crops from devastators, may they be men or cattle, bird or beast, rats or insects.

Inspite of the difficulties referred to above the following operations were undertaken :—

Locality.	Pest.	Crop.	Operations.	Remarks.
Chak 355 ...	Citrus Aleurodidæ.	Maltas, etc. ...	Spraying .	200 trees sprayed.
Jhang ..	Ditto ...	Ditto ...	Ditto ...	82 Ditto.
Sargodha ...	Citrus Psylla ...	Orange, etc. ...	Ditto ...	60 Ditto.
Rawalpindi ...	Ditto ...	Ditto ...	Ditto ...	74 Ditto.
Lahore ...	Mango-hopper...	Mango ...	Ditto ...	110 Ditto.
Sialkot ...	Cabbage butterfly	Cabbage ...	Ditto ...	...
Ferozepore ...	Citrus Aleurodidæ	Citrus ...	Ditto ...	115 trees sprayed.
,, ...	Rice bug ...	Rice ...	Bagging ...	4 Bighas treated as a demonstration.
Karnal ...	Ditto ...	Ditto ...	Ditto ...	8 Bighas treated as a demonstration.
Gurgaon ...	Rice Grass-hopper	Ditto ...	Ditto ...	2½ Acres treated as a demonstration.
Gurdaspur ...	Pyrilla ...	Cane ...	Ditto ...	½ Acre.
Lyallpur ...	Ditto ...	Ditto ...	Ditto ...	4 Acres.
Ferozepore ...	Ants ...	In house-hold. & stores.	Potassium cyanide.	Most successful remedy.
Lyallpur ...	Ditto ...	Ditto ...	Ditto ...	...
Sargodha Seed Farm	Ditto ...	Ditto ...	Ditto ...	...
Lahore ...	Ditto ...	Ditto ...	Ditto ...	...
Mehdiabad ...	Ditto ...	Ditto ...	Ditto ...	...
Lyallpur ...	Wasps ...	Bungalow ...	Phenazol ...	...
Ambala ...	Rats ...	Race course ...	Fumigation	597 Burrows.
Jharauli (Karnal)	Ditto ...	Grass Gram ...	Ditto ...	48 Burrows.
Gurdaspur ...	Ditto ...	Wheat, Cane ...	Fumigation and baiting.	3,984 Burrows.
Kiryal (Montgomery).	Ditto ...	Garden ...	Fumigation	477 Burrows.
Sialkot ...	Ditto ...	Grass ...	Ditto ...	120 Burrows.
Shakargarh (Gurdaspur).	Khapra ...	Wheat godown...	Superheating	...
Lyallpur ...	...	Ditto ...	Fumigation	...

II. Entomological.

Cottons.—After 3 bad years the cottons improved again and the outturn was good. The 'spotted bollworms' *Earias insulana* Boisd and *E. fabia* Stoll. kept within bounds and did not call for any special measures. Particular attention was devoted to the parasites of these bollworms and 13 different species were recorded. Life histories of most of these were studied. (A paper on the subject was contributed to the Entomlogical Meeting). The efficacy of these parasities in checking the bollworms is highly doubtful. It had been noticed during the past years that buds and bolls attacked by the bollworms often dropped off during wind and rain. Collections of buds and bolls were made from the ground after heavy showers and percentage of those attacked noted down. The data thus collected showed that as many as 87 per cent. of the bolls which drop off during wind and rain might be attacked. Shaking the plants and flooding the fields *i.e.*, 'rope dragging and flooding' seems in light of the above observations to be a measure that could be effective in reducing the number of bollworms. Experiments along these lines were tried on a small scale with encouraging results. In one case the attack before the operation was 23·1 per cent and after the operation it was reduced to 7·3 per cent. Extensive observations are required before one can definitely decide as to the value of this remedial measure.

The "notorious pink bollworm"-*Platyedra gossipiella* Saund. which has been stated to be of minor importance as a pest in the Punjab was found to be present in alarming numbers in certain localities, particularly Sialkot and Ferozepore. From a sample of cotton lint and seed from Sialkot weighing 373 tolas 370 living caterpillars were obtained and from a similar sample from Ferozepore weighing 44 tolas, 141 caterpillars were collected. Most of the caterpillars were found hibernating in the lint in flimsy silken cocoons. Samples taken from the seed which was to be sown were absolutely free from the pink bollworm. From this it appears that infestation most probably is not carried to the fields with the seed but the moths fly to the growing crop from cotton godowns. This insect is one of the most serious pests of cottons and careful investigation is needed.

The "cotton stem borer" *Sphenop'era gossypii* Kerr. was reported from Lyallpur and Rohtak. Many attempts to study the life history of this insect were made but on account of the unsuitable conditions prevailing in our rearing room not one complete cycle could be studied. Unfortunately the details of its life history are not known from any part of India. Systematic removal and burning of the attacked plants is effective in checking the increase of this pest. A very large number of cotton sticks left standing in the fields after picking were examined and found to contain grubs and pupae of this beetle. In some cases as many as 51. 5 per cent of the sticks were attacked. Safe disposal of the remnants of crop if carried vigorously is sure to exterminate this pest. Legislation is badly needed to enforce people to do this. All cotton sticks and stubbles must be destroyed before the new crop is sown.

The cotton-weevil *Myllocerous blandus* Fst. which at one time appeared to come into notoriety by damaging germinating cotton and maize plants has fortunately ceased to do any material harm.

Sugarcane, Maize and Jowar.—The study of the moth borers was taken in hand. Stubbles and dead hearts collected from all over the Punjab revealed the important fact that while *Chilo simplex* Butl. is the main pest of maize and jowar the borers damaging the sugarcane are—*Diatraea auricilia*, *Emmalocera sp.* and *Scirpophaga sp.* and these have not so far been taken from Jowar.

Thus the idea of maize as trap crop for sugarcane must be given up. Further investigations confirm us in the belief that the only solution lies in "safe disposal" of the stubbles.

Moth borers hibernate in stubbles uptil March and if stubbles are collected and burnt before the end of this month the pest is sure to disappear soon.

Citrus.—Citrus growing is very popular in the canal colonies, but just as fast as the new groves are being planted the old ones are ceasing to produce fruit and both the Psylla and Aleurodidae are spreading at a rapid rate. The psylla can be easily checked by spraying but the Aleurodidae have proved more difficult of control. These much flattened insects are provided with tough covering and further attach themselves to the underside of the leaf and are consequently very difficult to kill by spraying. One spraying kills about 60 per cent. and therefore 3 or 4 operations must be performed. Life history of these Aleurodidae is under investigation. Proper steps must be taken immediately to control this disease and the most urgent of these is to give a special Agricultural Assistant for citrus pest investigation and a number of fieldmen for spraying. Irresponsible sale of seedlings must also be stopped.

Mango.—As predicted in my report last year mango-hopper has not been very bad so far, but it is showing signs of recovery.

Stored Grains.—Superheating has proved a very effective and economical way of dealing with infested godowns. Experiments on air tight storage have not so far yielded results of practical utility. The Elevator was found heavily infested with weevils at the end of the season. All the bins have been cleaned for the incoming grain. It is unfortunate that no restriction is imposed on the storage of weevilled wheat and nothing has been done to instal a heating machine which is the only way of effectively dealing with the insects of "Stored grains."

Parasites.—Work on the parasites of the pests was continued. The year 1922-23 seems to have been very suitable for parasites as we found them in very large numbers. Two papers on the subject were contributed to the Fifth Entomological Meeting held at Pusa during February 1923.

Two species of the egg parasites of *Euproctis fraterna* Mo. were bred in large numbers and reared successfully for many generation on eggs of different pests. During May the heat killed them all.

The parasites of citrus psylla were also studied in detail and a number of new species recorded. *Tetrastichus radiatus*. Watsn. which is a very effective check on citrus psylla in certain localities of the Punjab is attacked by a hyper-parasite.

During March and April larvae and pupae of *Coccinella punctata LI* and *Adonia doubledayi Muls.* were found to be heavily parasitized by a small chalcid. Some work was done on food and other conditions suitable for the life of parasites. From 36 different species of hosts quite 3 dozen different species of parasites were bred. The observations made shall be published as soon as possible.

III.—Zoological.

Rats.—Reports of serious rat attacks were received from all over the province. In some places the attack was so severe that the villagers found it impossible to obtain bare subsistence from their land. Even land revenue could not be recovered from certain villagers.

Poisoning and fumigation gave very satisfactory results. Poison baits if sown systematically and simultaneously over large areas are the best and cheapest means of rat eradication. Entomological Section can do no more than demonstrate the methods of dealing with this vermine. For checking rats well organized campaigns backed by local officers and financed from local funds must be started over large areas.

The age of "pipers," is over and we must exert for what we wish to attain and every possible effort should be made to conquer the animal which spread plague and causes death of millions of human beings and devastates crops worth hundreds of thousands of rupees.

Sericulture.

The amount of silk seed distributed in the province during 1922-23 (1,392 ounces) was half of what was distributed in 1921-22 (2,845 ounces). No staff has been sanctioned for sericulture and the rapidly increasing Entomological work makes it impossible for the Entomological staff to devote much time on the silk industry. Inspite of a decrease in the amount of seed distributed the output is the same as last year. The quality was on the whole very good and the prices realized were slightly higher. The produce of the best rearers fetched Rs. 242 per maund of dry cocoons. Success of silkworm rearing depends amongst other things, on the quantity of seed reared by one family. Silk rearers insist on rearing more than they can manage. Efforts were made to reduce the quantity of silk seed per family and 1,392 ounces were distributed amongst 608 rearers in 1923 as against 2,945 ounces amongst 880 rearers in 1922. The income per head of rearer was Rs. 49. The higest yield was 18 seers 12 chks and fetched Rs. 107-13-0—this at his own home and with real hard work for only 15 days. Silk Exhibition and auction was held at Gurdaspur on 26th and 27th May 1923. About 300 people attended and Rs. 480 given as prizes. Experiments on rearing early in the season were started but no definite results could be obtained on account of the heat wave in the 3rd week of March.

We aim at avoiding the hot winds of early April and if we attain this then the success of sericulture as a cottage industry is ensured.

Mulberry Plantations.

Mulberry plantations on the west banks of the Upper Bari Doab Canal have been extended. About 7,000 seedlings were transplanted during 1922-23. The plantantions are in excellent condition and were used for rearing silk worms this year. There is a large percentage of early varieties and this makes it possible to start rearing early in the season. A new mulberry plantation has also been started near Kunjar on the banks of the Upper Bari Doab Canal. District Board Mulberry plantation at Kot Nainan, Sujanpur and Behrampur were taken over and are being improved.

Mian Himayat Ali Khan, Tahsildar, Shakargarh (Gurdaspur) has taken great interest in sericulture and has helped us in distributing 1,000 mulberry seedlings amongst the zemindars of this tahsil. If we can get the zemindars interested in sericulture we shall be doing enormous good to the cultivator class.

Thanks to the help given by Mr. G. Anderson, Director of Public Instruction, Punjab. Sericulture in schools is progressing favourably. About 1,900 mulberry seedlings were distributed to the Agricultural Schools and I must thank Lala Lachhman Dass, Assistant Inspector of Agriculture, Punjab, for his help in this work.

Lala Dina Nath and Lala Umrao Bahadur have both worked with great energy and enthusiasm throughout the year and have made valuable contribution to our knowledge of the pests of the main crops of the Punjab and their parasites.

Success in Sericulture and Mulberry Plantations is the result of the efforts of Sayed Abdullah Shah. He has worked with tact and enthusiasm.

M. AFZAL HUSAIN,

Entomologist to Government, Punjab,

Lyallpur.

APPENDIX V.

Annual Report of the Agricultural Engineer to Government, Punjab, Lyallpur, for the year ending 30th June 1923.

Introductory.—I have been in charge of the Engineering Section throughout the year.

Workshop.—As mentioned in last report, the machines in the workshop continue to be run by three oil engines as electric power is not yet available, the system is expensive and by no means efficient. Some machines purchased in 1920 cannot be run at all as they have been primarily designed for an electric drive and consequently the capital locked up in them is a direct loss, until they can be brought into use, the advantage of these machines being also lost for the time being

The necessary framing and table for a large circular saw has been constructed in the workshop, the gearing only having been purchased from British makers, the completed machine costing slightly over Rs. 7,000 compared with the makers quotations of over Rs. 20,000.

At the present time a five-tons travelling crane has been designed and is in process of construction, considerable saving is also anticipated on this item, over outside supplier's prices.

One deep chamber is at present in course of construction, this will be used for testing various types of water lifts and is one of a series of several such chambers that are required for this purpose and for which it is hoped funds will ultimately be provided. Electric power is very necessary for this work also, and very little useful investigation can be carried out until such power is provided.

During the year under report a variety of work was undertaken for the various sections of the Department, the work done for the college alone amounted to over sixteen thousand rupees, the total value of work done amounted to Rs. 94,600 yielding a profit of Rs. 5,050.

The workshop is run entirely by a working staff with the result that there is frequently considerable waste of material owing to lack of constant supervision.

There is not the slightest doubt that considerable saving could be effected by the employment of a Sub-Divisional Officer or Extra Assistant Director of Agriculture as Manager,—a saving sufficient to cover the pay of the appointment and leave a substantial balance.

The value of stores handled in the workshop amounts to Rs. 2,00,000 per annum, for this purpose a Storekeeper is employed on a salary of Rs. 40—2—90 per mensem—a wholly inadequate remuneration for the type of man and the class of work required, the result being that twenty storekeepers have been employed during the past eight years and the stores registers are very imperfectly kept. I estimate that the leakage due to inefficient recording of stores would more than pay for the services of a competent storekeeper.

My frequent suggestions for the appointment of the necessary staff for the economic management of the workshop have, so far, been without result, and as stated above, I am confident that there will be an actual saving, after paying the salaries of the staff, so I trust that the economic aspect of the case will receive that consideration which it deserves.

Boring Plant.—The power plant made up at Lyallpur has been under further trials and some slight modifications made in the design have considerably lowered manufacturing costs. This plant has recently been sent out to Ferozepore for sinking a 15″ bore and the work is proceeding much more rapidly than under the old system, while only one-third of the labour is required. The machine has been placed on the market and is manufactured by Messrs. The Crowder Engineering Works Company, Limited, Karachi, the present cost being Rs. 1,400 and with the addition of a suitable small power driving unit costing Rs. 1,350 the complete boring plant amounts to one-third of the cost of imported plant. This is of more complicated design and less efficient action in Punjab soils.

The power boring plant having proved successful it was considered worth trying if a suitable hand boring plant on similar lines could be designed, in order to speed up the work of boring in ordinary wells, and if possible to reduce the amount of labour required. A machine was ultimately designed, and a pattern made up and thoroughly tested. The tests proved most satisfactory and modifications were made in the design, which, while retaining the essential features of the machine rendered it more easily and cheaply manufactured. This machine was placed on the market a few weeks ago and the complete hand boring equipment costs only two-thirds of the price of hand plant of the type that has been in use for the past fifteen years.

The net cash saving in replacing the worn out plant with plant of the new type, instead of with the old type, amounts to forty thousand rupees. In addition to this, work is more rapidly carried out with the new plant and it requires less labour to manipulate it; what saving will be effected in this way, it is yet too early to estimate, but a substantial sum is anticipated.

Stoneware Strainers.—A length of 36 feet of octagonal stoneware strainer was sunk in a twelve-inch casing tube at Lyallpur. The bore was made deep enough to permit of efficiency tests being carried out by the air lift system. The small air compressor required for this purpose has not yet been sanctioned and this line of investigation has consequently been abandoned for the time being.

It was the intention to substitute small size stoneware strainer for the copper strainers at present in use in ordinary boring work, as these are very considerably cheaper than the copper type. This work could not be undertaken on account of lack of staff, although it would have meant a direct cash saving both to Government and to the well owner. It is hoped that the necessary sanction to carry on work in the most economical manner will not be further delayed.

Stoneware slips and rings for these tubes have been made at Sialkot and Lyallpur, and when the work is supervised excellent material is produced, but without close supervision there is a tendency to produce slightly irregular forms, not too well fired. It is proposed to import from Staffordshire a certain quantity of these slips and rings with the object of keeping up the standard of those which are produced in India.

Persian Wheels.—In last report I mentioned that an i expensive form of self-lubricating roller-bearer had been designed for Persian wheel. During the year under report the design of complete Persian wheels was investigated and a form produced in which the three wheels are interchangeable, thus simplifying construction. As each one of the three wheels is not performing identical duties, the form of design permits of them being interchanged after considerable wear has taken place and thus lengthening the life of the complete wheel. Unfortunately the metal wheel is considerably more expensive than the more common wood type, and unless its life is considerably greater, combined with very much freer working, there will be no justification for its production. Several test wheels have been made and these are gradually being modified with a view to obtaining low constructional cost combined with substantial design and free movement. It is hoped ultimately to produce a scientifically designed machine of reliable and substantial construction and at a reasonable cost; so far this object has not been achieved.

Ploughs.—A certain amount of work has been done during the year in investigating various curves with the idea of producing a plough to meet the general requirements of the Punjab cultivator from a work point of view, and which will offer as little resistance as possible during movement. For further progress in the work it is necessary that observations be made of resistances of these curves to the displacement of soil. Lack of the necessary apparatus has caused postponment of this work.

Wellboring.—The staff of three supervisors and twenty borers maintained for the augmentation of water supply in ordinary wells has remained at full strength throughout the year. Unfortunately the worn out condition of the boring plant has seriously handicaped the output of work. This plant has been in use for many years, and during the last few years financial stringency has prevented its renewal and consequently the bill for repairs has become heavier each year, while the efficiency of the plant has diminished. The number of wells bored amounts to 273 as compared with 343 during the previous year, the percentage of success being 80·22 against 82·2 while the number of strainers sunk amounts to 61 compared with 72 in the previous year. The decline in the number of wells bored is accounted for by the continued use of inefficient boring plant requiring a longer time for the execution of the work, and in addition, a certain reluctance on the part of some well owners to pay an overhead charge of Rs. 50 per boring.

For the past fifteen years this boring work has been very heavily subsidised by Government, the pay of the borers and their mates, the pay

of the well supervisors, travelling and office expenses of these men and head office expenses, all being paid by Government. In addition to this the tubes used were charged for at less than cost price during the war years. Nothing was charged to the well owners for interest on capital sunk in boring plant, or for depreciation and the repair to it which in recent years have been extremely heavy.

During the last eight years I have been advocating the placing of this boring work on a self-paying basis and it was only three years ago that the Director of Agriculture agreed that a step in this direction might be tried. A detailed scheme was drawn up, which embraced (*a*) the provision of up-to-date boring plant, (*b*) improved scale of pay for borers and their assistants, (*c*) the addition of a Sub-Divisional Officer to the boring staff, (*d*) the levying of an overhead charge of Rs. 100 on each successful boring made in order to cover the charges which have been met by Government in the past. This scheme was approved in principle by Government in September 1922 but sanction has not yet been accorded to all the various items of the scheme. For example, an improvement in pay to the borers and their assistants was the first item to be sanctioned and this was accorded in July 1922 with retrospective effect from 1st April 1922. The purchase of only one-fourth of the boring plant required was sanctioned in May 1923 and as this takes a considerable time to obtain, the first sets have not yet been received. The result is that borers and their assistants have for the past fifteen months been drawing a scale of pay out of proportion to the work they are doing and have not yet been provided with the necessary tools, a procedure which is most unbusiness-like and detrimental to progress. The fixing of a sum of Rs. 50 per well as an overhead charge will not place the boring work on a self-paying basis and consequently the hands of the Department are tied with regard to placing additional borers in districts where there is a demand for their services and in which the well owners are only too willing to pay the fee of Rs. 100 overhead charges. In addition, the fixing of the fee at Rs. 50 has retarded progress in some districts in which boring operations have been carried on for many years under Government subsidy. If the application of the overhead charge had been left to the discretion of the Director of Agriculture, as suggested, there is not the slightest doubt that greater progress would have been recorded.

The new boring plant to be applied to this work will require considerably less labour, and be more expeditious than the old plant, hence if the overhead charge had been levied along with the introduction of this plant the well owner would not have felt the imposition of the overhead charge as he now feels it.

The Sub-Divisional Officer required under the reorganization scheme has not been sanctioned yet and the installation of new type boring plant and a new system of boring, and the making up of cheap strainers can not be undertaken without the necessary staff.

The overhead charges recovered on wells bored after 1st October 1922 amounts to Rs. 7,350 and the receipt of this sum marks the first

step in placing this boring work on self-supporting lines. The total subsidy paid by Government during the past eight years has amounted to rupees thirty to thirty-five thousand per annum. In the year under report this sum has been reduced to rupees fifteen thousand and if my suggestions are followed, then I can guarantee that ultimately there will be no loss to Government on this work and that the work of this section will increase. It is hoped that all details of the reorganization scheme will be sanctioned at an early date in order to facilitate the work for which there is a strong demand.

Tube wells.—Many enquiries have been received during the year for particulars and prices of tube-wells, but none of these have matured on account of the high cost of plant and the decline in market prices for grain, etc. In the early part of the year under report, the tube well in Bahawalpur State was completed and tested. This tube is electrically driven by a vertical motor coupled to a vertical spindle turbine pump and was installed for a discharge of one and a quarter cusecs. The yield amounted to 30,000 gallons per hour and the energy consumed is 8·8 Kilowatts. A second tube-well under construction at Dera Ismail Khan was completed and tested in May, the yield being one and a quarter cusecs, or twenty-eight thousand gallons per hour. The boring at Gujrat mentioned in last report has given an exceptional amount of trouble, some eighty feet of hard non-porous soil was pierced and the underlying stratum proved to be of excellent water bearing quality.

Unfortunately a spring dart was broken in this material and many months have been wasted in making special tools and in endeavouring to remove this obstruction, which is at a depth of close on two hundred feet from ground surface. It will be necessary to abandon this work and resink the casing tube alongside the old bore.

The boring at Makerwal being made for the Makerwal Colliery Company was carried down to a few feet below sub-soil water level which was found at a depth of 200 feet. At this stage the villagers on whose land the operations are being conducted, stopped further work until a dispute between them and the Colliery Proprietors, regarding ownership of the land shall be settled.

Nothing further has been done with regard to the College water supply at Lyallpur for which a bore was sunk four years ago. This tube-well was to have been worked electrically and was exprimental with regard to the quantity of water to be withdrawn. As there is no indication of electrical energy being available in the near future I would suggest that this scheme be modified and the work proceeded with, as the necessity for an adequate supply of water at the College, is very marked.

I may state that on the tube-wells completed by this Department up-to-date, a total sum of Rs. 14,845 has been credited to Government for depreciation of plant and departmental expenses.

Battery Tubes.—During the year I have investigated several proposals for irrigating large tracts by a battery of tube-wells, and in districts where the sub-soil water is at a depth to render irrigation

costs above the economic limit, these areas have been examined in conjunction with areas where irrigation costs are well below the economic limit.

A scheme for pumping water from the sub-soil, thereby permitting the closure of canal supplies in the water-logged districts of Hafizabad and Gujranwala was drawn up and submitted to the Irrigation authorities. Such a project worked in conjunction with a lift from the sub-soil irrrigation scheme on uncommanded areas, reduces the cost of irrigation water to within the economic limit, in addition to reclaiming the water-logged areas. Many such schemes might be carried out by private enterprise, thus saving Government the capital cost, while considerable areas would be brought under cultivation.

Teaching.—Lectures in Civil Engineering as applied to Agriculture covering a period of three hours per week are delivered to the students of the third year class. In addition to this, a short course of ten lectures with practical field work in Land Surveying, is given to all second year students. A course of practical work in carpentry and some smith work is given by the carpenter and smith to first and second year students for a period of 5 hours per week. This course could be improved very materially if a properly trained assistant was available to take over these classes in practical work, and the expense involved would be more than saved on account of close supervision in the workshop where considerable waste takes place owing to lack of staff required for necessary supervision.

Private Schemes.—A scheme was prepared in detail for utilizing water power available in an estate in the Hassan Abdal District for running a small flour mill, driving a ram for irrigation of high land, and for generating electricity. It is probable that this work will be carried out in the near future.

Acknowledgment.—I wish to acknowledge my indebtedness to the staff for the manner in which they have worked throughout the year. Each man has considerably more work than he can reasonably be expected to handle ; and in spite of these adverse conditions, some work of real benefit to the Punjab, has been accomplished.

T. A. MILLER BROWNLIE,

Agricultural Engineer to Government, Punjab, Lyallpur.

APPENDIX A.

WELL-BORING.

Serial No.	Name of District.	Wells.		Remarks.
		Number of Bores.	Successful.	
1	Multan	27	26	Ludhiana Circle. Percentage of success 84·16. Out of 120 there were 5 trial bores, all of which were successful.
2	Ferozepore	31	22	
3	Lahore	35	29	
4	Ludhiana	13	10	
5	Muzaffargarh ...	14	14	
	Total ...	120	101	
6	Jullundur	18	16	Jullundur Circle. Percentage of success 76·63. Out of 107 there were 13 trial bores all of which were successful.
7	Hoshiarpur ...	31	13	
8	Gurdaspur ...	8	7	
9	Gujranwala ...	3	3	
10	Sialkot	14	13	
11	Gujrat	10	8	
12	Amritsar	23	22	
	Total ...	107	82	
13	Gurgaon	19	17	Rewari Circle. Percentage of success 78·2.
14	Ambala	8	6	
15	Karnal	14	9	
16	Rohtak	5	4	
	Total ...	46	36	
	GRAND TOTAL ...	273	219	Percentage of success 80·22.

APPENDIX B.

Details of strainers used in wells in the Punjab.

Circle.	District.	Prior to July 1916.	Prior to July 1917.	Prior to July 1918.	Prior to July 1919.	Prior to July 1920.	Prior to July 1921.	Prior to July 1922.	Prior to July 1923.	Average yield of wells before strainer was used. (Gallons per hour)	Average yield of wells after strainer was used. (Gallons per hour.)	Average cost per well.	Remarks.
												Rs.	
Jullundur Circle.	Hoshiarpur ...	8	52	79	91	103	122	131	131	559	1,965	134	
	Amritsar ...	9	31	50	54	79	113	125	130	761	3,727	225	
	Jullundur ...	...	1	1	1	1	1	1	1	930	3,000	180	
	Sialkot ...	...	6	13	39	60	74	79	90	623	3,502	139	
	Gurdaspur ...	...	...	8	13	25	36	39	44	946	3,502	157	
	Gujranwala ...	...	...	2	23	28	41	41	41	615	2,361	146	
	Shahpur ..	...	...	...	...	...	1	1	1	...	1,000	125	
	Gujrat ...	...	...	...	...	1	1	1	2	872	2,462	148	
	Sheikhupura ...	...	...	...	...	...	...	3	3	690	3,500	300	
Ludhiana Circle.	Ludhiana ...	9	14	20	30	41	48	49	49	401	1,891	163	
	Montgomery ...	4	16	16	16	16	16	16	16	630	2,600	150	
	Lahore ...	...	47	85	106	123	145	154	167	655	2,235	159	
	Multan ...	...	6	25	41	47	66	78	88	693	1,918	158	
	Ferozepore ...	...	...	7	21	31	36	41	48	878	2,772	188	
	Muzaffargarh ...	...	...	...	...	...	7	18	26	480	2,568	152	
	Bahawalpur ...	...	...	...	...	...	4	4	4	593	9,537	349	
Rewari Circle.	Gurgaon ...	...	2	3	3	3	3	3	3	600	2,300	150	
	Karnal ...	1	3	5	25	52	70	72	72	607	2,561	103	
	Ambala ...	...	...	3	8	10	12	12	13	815	3,671	155	
	Total ...	31	178	317	471	620	795	868	929	686	3,004	170	
										Average.			

APPENDIX C.

Since July 1922 to 30th June 1923.

Circle.	District.	No. of strainers.	Average yield of well before strainer was used. (Gallons per hour.)	Average yield of well after strainer was inserted. (Gallons per hour.)	Average cost per well.	Remarks.
					Rs. A. P.	
Jullundur.	Gurdaspur ...	5	600	3,500	216 0 0	
	Sialkot ...	11	800	4,000	182 0 0	
	Gujrat ...	1	1,200	3,000	160 0 0	
	Amritsar ...	5	1,000	4,200	180 0 0	
Ludhiana.	Lahore ...	13	781	2,650	199 0 0	
	Ferozepore ...	7	1,094	3,818	194 0 0	
	Muzaffargarh ...	8	750	2,675	149 0 0	
	Multan ...	10	937	2,112	170 0 0	
Rewari.	Ambala ...	1	...	2,886	116 0 0	

APPENDIX D.

APPENDIX

Comparative statement showing income and expenditure of the

Year.	Name of circle.	No. of well borers.	No. of wells bored.	Average percentage of success.	Total cost of Establishment.
1	2	3	4	5	6
					Rs. A. P.
1921-1922 ...	Ludhiana ...	7	133	80 %	8,255 0 0
1922-1923 ...		7	120	84 %	9,079 0 0
1921-1922 ...	Jullundur ...	7	147	86 %	8,238 0 0
1922-1923 ...		7	107	76·63	8,142 0 0
1921-1922 ...	Rewari ...	5	63	80 %	7,085 0 0
1922-1923 ...		5	46	78 %	7,642 0 0
	W. I. Pipes.				
	Stock in hand on 30th June 1923.		2½"	3½"	4"
			1,081'—4" at Re. 1-8-0 per foot = Rs. 1,622-0-0	6,592'—10" at Re. 1-14-0 per foot = Rs. 12,361-9-0	11,308' at Rs. 2-8-0 per foot = Rs. 28,270-0-0

D.

well-boring department during 1921-22 *and* 1922-23.

Cost of pipes and strainers.	Cost of repair of tools.	Total of columns 6, 7 and 8.	Money realised.	REMARKS.
7	8	9	10	11
Rs. A. P. 1921-22 = 22,237 0 0 1922-23 = 13,300 0 0	1921-22 = 6,244 0 0 1922-23 = 3,777 0 0	1921-22 = 52,059 0 0 1922-23 = 41,940 0 0	1921-22 = 18,786 12 6 1922-23 = 27,143 12 8	Difference in Expenditure and Income— Rs. Expenditure ... 52,059 Income ... 18,786 Direct loss to Government during 1921-22. 33,273 Difference in Expenditure and Income— Rs. Expenditure ... 41,940 Income ... 27,143 Direct loss to Government during 1922-23. 14,797
			Strainers.	
5"	6"	7"	2½"	3½"
1,717'—6" at Rs. 3-0-0 per foot = Rs. 5,152-8-0	3,379'—6" at Rs. 3-10-0 per foot = Rs. 12,250-11-0	1,000' at Rs. 5-0-0 per foot = Rs. 5,000-0-0	893"—0" at Rs. 10-2-0 per foot = Rs. 9,092-4-0	536'—0" at Rs. 17-6-0 per foot = Rs. 9,313-0-0 } Total Rs. 83,062.

APPENDIX

Agricultural Workshop income received from sale of material, energy, etc.,

Particulars of income.	April 1922.	May 1922.	June 1922.	July 1922.	August 1922.	September 1922.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Electrical charges	78 0 0	17 0 0	31 0 0	52 8 0	184 12 0	58 0 0
Works executed for private persons.	22 8 3	40 1 6	9 12 0	24 13 9	981 1 6	29 9 9
Gas tar ...	53 4 0	51 0 0	24 0 0	39 0 0	30 8 0	30 0 0
Total ...	153 12 3	108 1 6	64 12 0	116 5 9	1,196 5 6	117 9 9

*This includes an amount of Rs. 269-15-0 on

		Rs.	A.	P.
Machinery charges	... ...	=157	5	0
Overhead „	... ...	=112	10	0

E.

and credited into Government Treasury during the financial year 1922-23.

October 1922.	November 1922.	December 1922.	January 1923.	February 1923.	March 1923.	Total.	Remarks.
Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
40 0 0	113 0 0	31 8 0	66 0 0	64 8 0	68 8 0	804 12 0	
242 0 0	445 13 0	60 10 0	249 0 0	164 2 6	1 4 0	2,270 12 3	
169 8 0	75 8 0	103 8 0	1 8 0	7 8 0	49 8 0	634 12 0	
451 8 0	634 5 0	195 10 0	316 8 0	236 2 6	119 4 0	3,710 4 3	

account of overhead and machinery charges as follows—

	Rs. A. P.
Total	... 269 15 0

APPENDIX

Annual statement showing value of work done in Agricultural Workshop

Name of section for which work done.	Labour.		Material.	Overhead charges.
	Permanent staff.	Daily paid.		
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Agricultural ...	47 8 0	292 15 9	505 1 0	60 15 6
Botanical ...	58 9 6	242 0 0	420 13 0	49 10 0
Entomological ...	45 6 0	279 3 0	273 0 0	63 11 0
Chemical ...	110 13 0	539 7 6	300 4 0	116 1 0
College ...	1,495 8 0	1,279 13 6	13,462 7 9	342 13 0
Engineering (Workshop).	737 3 0	4,610 13 9	27,870 8 0	532 9 0
Private ...	133 9 0	*	296 6 0	112 10 0
Boring ...	190 2 0	1,895 4 3	36,762 13 6	209 15 0
Total ...	2,818 10 0	9,129 9 3	79,891 5 3	1,488 4 6

* Daily labour met

F.

or various sections, during the financial year 1922-23.

Machinery charges.	Total value of work done.	Sanctioned allotment.	Remarks.	
Rs. A. P.	Rs. A. P.	Rs. A. P.		Rs. A. P.
57 4 0	963 12 3	850 0 0	Workshop actual expenditure according to Contingent Register	55,686 13 3
41 8 0	812 8 0	1,000 0 0	Boring actual expenditure according to Contingent Register ...	33,888 13 6
14 6 0	675 10 0	2,000 0 0	Total ...	89,575 10 9
			Value of work done	94,628 9 9
			Expenditure ...	89,575 10 9
88 9 0	1,105 2 6	1,500 0 0	Profit ...	5,052 15 0
78 4 0	16,658 13 9	16,500 0 0		
368 10 9	34,174 12 6	33,650 0 0		
157 5 0	699 14 0	..		
549 14 0	39,608 0 9	35,000 0 0		
1,800 12 9	94,628 9 9	90,500 0 0		

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY.

from private advances.

APPENDIX G.

Statement showing overhead and machinery charges levied on all works executed in the Agricultural Workshops during the financial year 1922-23.

NOTE.—Levying of machine charges was only commenced in September 1922 and this statement does not include all machines.

Name of Section.	April 1922.		May 1922.		June 1922.		July 1922.		August 1922.		September 1922.		October 1922.	
	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Agricultural	10 6 0	...	8 15 0	...	13 0 0	...	1 11 0	...	1 2 0	...	24 10 0	6 12 0	1 6 0	1 8 0
Botanical	3 3 0	...	1 10 0	...	20 8 0	...	1 9 0	...	2 12 0	...	3 5 0	6 12 0	7 15 0	17 4 0
Entomological ...	2 10 0	...	1 11 0	...	30 10 0	...	2 9 0	...	3 0 0	...	1 10 0	4 0 0	8 12 0	3 8 0
Chemical	11 12 0	...	17 0 0	...	14 14 0	...	4 9 0	...	7 7 0	...	11 10 0	12 8 0	3 0 0	2 8 0
Engineering (Workshop) ...	61 14 0	...	34 8 0	...	46 6 0	...	66 11 0	...	77 14 0	...	55 12 0	42 12 0	64 3 0	43 0 0
College	61 14 0	...	49 6 0	...	30 14 0	...	23 8 0	...	26 14 0	...	23 14 0	7 12 0	25 9 0	7 0 0
Boring	19 8 0	...	4 12 0	...	8 1 0	...	18 4 0	...	18 8 0	...	20 4 0	80 8 0	20 8 0	25 4 0
Private	12 2 0	...	7 4 0	...	12 4 0	...	6 1 0	...	5 4 0	...	11 8 0	10 8 0	6 8 0	18 4 0
Total	183 5 0	...	125 2 0	...	176 9 0	...	124 14 0	...	142 13 0	...	152 9 0	171 8 0	137 13 0	118 4 0

APPENDIX G—CONCLUDED.

Statement showing overhead and machinery charges levied on all works executed in the Agricultural Workshops during the financial year 1922-23—concluded.

NOTE.—Levying of machine charges was only commenced in September 1922 and this statement does not include all machines,

Name of Section.	NOVEMBER 1922.		DECEMBER 1922.		JANUARY 1923.		FEBRUARY 1923.		MARCH 1923.		TOTAL.		GRAND TOTAL.
	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	Overhead.	Machinery.	
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Agricultural	1 11 0	2 8 0	3 8 0	18 0 0	2 2 0	10 8 0	4 9 6	18 0 0	0 12 0	...	73 12 6	57 4 0	131 0 6
Botanical	0 9 0	17 8 0	0 14 0	...	6 4 0	...	0 5 0	...	0 12 0	...	49 10 0	41 8 0	91 2 0
Entomological ...	1 13 0	3 6 0	1 4 0	...	6 6 0	...	2 0 0	3 8 0	1 6 0	...	63 11 0	14 6 0	78 1 0
Chemical	10 10 0	11 12 0	13 12 0	7 1 0	6 11 0	1 12 0	7 2 0	1 0 0	7 10 0	2 0 0	116 1 0	38 9 0	154 10 0
Engineering(Wor' shop) ..	54 15 9	21 4 9	15 4 0	216 10 0	10 6 0	1 8 0	21 6 6	6 0 0	23 5 3	32 8 6	532 9 6	303 10 9	896 4 3
College	22 8 0	13 12 0	14 4 0	30 8 0	22 1 0	4 8 0	20 10 0	6 8 0	21 7 0	8 4 0	343 13 0	78 4 0	421 1 0
Boring	26 0 0	120 8 0	9 4 0	210 10 0	34 6 0	37 0 0	6 0 0	46 0 0	18 8 0	...	203 15 0	549 14 0	753 13 0
Private	4 6 0	10 8 0	24 10 0	102 8 0	10 2 6	1 3 0	8 11 0	12 10 0	3 13 6	2 0 0	112 10 0	157 9 0	270 3 0
Total ...	122 8 9	201 2 3	82 12 0	615 5 0	98 6 6	56 7 0	70 12 0	93 10 0	77 9 9	44 12 0	1,495 2 0	1,301 0 9	2,796 2 9

APPENDIX H

Statement of charges made against private tube-wells up-to-date sunk by this Department.

No.	Name and locality of tube-well.	Pay of Mechanic borer.	Depreciation of plant.	Departmental charges= 2½% Punjab 5% Foreign.	Grand Total.	Remarks.
		Rs.	Rs.	Rs	Rs.	
1	Khaka, Gujranwala District.	104	50	125	279	
2	Kaloo Shah, Amritsar District.	300	50	134	434	
3	District Board Garden, Ferozepore.	250	50	150	450	
4	Muzang Water Works, Lahore City.	385	50	47	482	
5	Th. Mahan Chand, Kishanpura, Amritsar District.	181	50	135	366	
6	Ajnala, Amritsar District	29	50	126	205	
7	Dhapai, Gurdaspur District.	251	50	193	494	
8	Jalalabad, Ferozepore District.	703	50	200	953	
9	Dairy Farm, Lahore ...	254	50	277	581	
10	Dera Ismail Khan City (I).	879	50	506	929	N.-W. F. Province.
11	Guru Har Sahai, Ferozepore District.	529	50	197	776	
12	Chak Hiraj, Ferozepore District.	528	50	386	964	
13	Reboring Jalalabad, District Ferozepore.	1,139	50	241	1,430	
14	Muzaffargarh ...	237	50	173	460	
15	Bahawalpur ...	1,297	50	1,294	2,641	Native State.
16	Dera Ismail Khan City (II).	1,668	50	1,133	2,851	N.-W. F. Province.
	Grand Total ...	8,228	800	5,317	14,345	

APPENDIX VI.

Report of the Professor of Agriculture, Lyallpur, on District work for the year ending 30th June 1923.

Staff and District.—I have been assisted throughout the year in the execution of the work in the district by Ch. Mohammad Abdullah, Deputy Director of Agriculture in the Lyallpur Colony and S. Charan Singh, Extra Assistant Director of Agriculture in the Montgomery Circle. D. P. Johnston, Esquire, Deputy Director of Agriculture, also assisted throughout the whole circle. I held charge during the year.

Work was continued all over the circle and staff stationed at various centres in it as described in last year's report. The system has worked exceedingly well. Much more has been accomplished than could possibly have been done with all the staff at one or two centres and travelling expenses have been reduced. Since last year's report the work has been extended in the Multan area. This district will ultimately, it is hoped, become an independent circle with a Deputy Director of Agriculture incharge. For the present, however, work is being carried on in it under the Lyallpur Circle and the activities of the Agricultural Department demonstrated in a stretch of country hitherto not penetrated by us. During the year one Agricultural Assistant was posted in this area at Muzaffargarh and one with a Muqaddam at Dera Ghazi Khan. The extra staff situated at various head-quarters throughout the circle at present number 11 Agricultural Assistants and 16 Muqaddams.

Season.—The season was on the whole broadly speaking favourable for the cotton crop and the reverse for wheat. The rains were fairly distributed throughout the year, except during May when abnormal falls greatly damaged the wheat at harvest over the greater part of the circle. The total rainfall recorded at Lyallpur was 9·43 inches as against an average of 8·85 for the last five years. Dull cloudy weather was experienced in December, January and February and as a result rust on the wheat crop was reported in the district by the middle of December. A severe local hailstorm occurred early in March and heavy rains in May. All these factors combined reacted adversely on the wheat crop reducing the yield and damaging the quality of the crop. Maize, sugarcane and toria did well. The latter was seriously damaged in certain parts of the circle by hails but the damage was more or less local. Cottons did very well, particularly American cottons which gave a good outturn. Desi cottons were somewhat below the normal. Insect pests and diseases were no more than average.

Farms.—The chief farm in this circle is the Lyallpur Agaicultural Station. A separate report in detail is submitted on it in Part II. The main work done during the year has been on the wheat, cotton and sugarcane crops whilst maize, toria, gram, etc., received attention also. Machinery forms an important part of the work of this farm and much progress was made with investigations during the year. Information of much use to us has been worked out and we are in a much better

position than heretofore to advise cultivators on these matters. This side of the work is particularly important here and is being developed accordingly, since this is the only departmental farm in the province where machinery has been installed on a somewhat wide scale.

In the wheat experiments, the main work has been a comparison of the varieties Punjab 11 and Punjab 8-A. The former in various degrees of purity is the variety commonly grown in these canal colonies. During the last few years the superiority of Punjab 8-A appears to be increasing. Out of a total of 91 comparisons under various conditions of cultivation, manure and irrigation on both good and poor land this year, Punjab 8-A gave the higher outturn in 84 cases. The average yields obtained under all conditions were :—

Punjab 8-A ...	...	13 Mds. 22 Srs.
Punjab 11 ...	...	11 Mds. 22 Srs.

Since three years ago when half the results were in favour of each variety Punjab 8-A has rapidly gone ahead till this year in only 8% of the comparisons is the balance against it.

American cottons did very well throughout on the farm, as also did Desis. In the sugarcane varietal tests a new variety coimbatore 205 was introduced this year and in outturn yielded the highest weight of gur ever obtained on this farm *viz.* 92·3 maunds per acre. The Suretha variety still continued to yield much more than the local varieties under varying conditions of manure and irrigation. Its superiority over the local cane is now fairly established.

The Montgomery seed farm was very successful throughout the year and is running at a very decided profit. Of the total area of 10 rectangles, three are at present under direct cultivation and the remainder worked by tenants. In the directly cultivated area some minor experiments on the main crops have been carried on in order to test the value of the Lyallpur results for the Lower Bari Doab Colony. The main object of the farm is, however, to supply pure seed and demonstrate in that district what can be attained by good seed and proper cultivation with improved implements. Cottons were very good generally. The yields from sugarcane were generally low, the average being only 30 maunds of gur per acre. Wheats though badly attacked by rust promised a fair yield but severe rains when the wheat was on the threshing floor damaged them to such an extent that our expectations as to the quantity of good seed which would be produced for distribution were doomed to disappointment.

It has so far been impossible to provide pucca buildings on this farm and the quarters of most of the tenants were in a miserable condition. It has, however, been possible to supply some good wood for the repair of their huts and it is hoped that an improvement will be effected. Money was also placed at our disposal this year for sinking a well. Lack of drinking water has always been on the greatest drawbacks to this farm. It is satisfactory to be able to note that the well is at present in process of being sunk.

The Demonstration Farm, Raewind, run by us for the Lahore District Board has had a successful year. It has suffered much from

scarcity of water for irrigation. Towards the end of the year the canal authorities have supplied it with a larger discharge pipe which it is hoped will lessen the difficulties hitherto experienced. Though the farm is only 46 acres in area it is one of the most successful of our demonstration farms, possibly indeed it may be the most successful for its size. It has been well laid out and capably managed by our Agricultural Assistant in-charge of work in that district. It is a demonstration farm in the true sense of the word and though only three years have elapsed since the land was first taken over and laid out in its present form it is now well known in the district and has been responsible for many zamindars growing our pure seeds and investing in better and improved implements. Financially this farm shows a very good profit considering the short time it is in existence.

The figures are—

	Rs.	A.	P.
Income	3,353	9	0
Expenditure	2,328	4	0
Profit	1,025	5	0

The expenditure includes all labour charges and also the pay of the Muqaddam in-charge. It does not include that of the Agricultural Assistant as he is incharge of the district work also.

The Co-operative Demonstration Farm in Chak 89/6-R. is only one rectangle in extent. The land is of inferior quality but is gradually improving. The income for the year was Rs. 702-7-0 and the expenditure Rs. 132-11-0 showing a gross profit of Rs. 569-12-0 excluding the pay of the Muqaddam who looks after the farm.

A Co-operative Demonstration Farm was started last year at Salarwala. Most of the laying-out work has now been done and it is expected that the farm when running properly will do much good in its district.

The Narwala Reh Farm though not now really connected with our work is still occasionally visited. It is reported that the area in which kallar has reappeared has somewhat increased since last year. This area now stands at 41 kanals as against 32, 18 and 12 kanals one, two and three years ago respectively.

The various demonstration plots throughout the circle continue to serve their purpose profitably and are visited by many zemindars in the respective districts.

Cotton.—Three successive years of partial failure of the American cotton crop coupled with only a very small premium for American over Desi cottons were responsible for a large decrease in the area under American cottons and more than corresponding increase in the sowings of Desi cottons in this circle. The areas under the cotton crop

in the two Canal Colonies of which this circle is composed were as follows :—

Lower Chenab Canal.

	1922.	1921.	Increase (+) or Decrease (−)
	Acres.	*Acres.*	
American cottons	118,311	196,562	− 39·8 %
Desi cottons ...	92,747	52,061	+ 78·1 %
Total	211,058	248,623	− 15·1 %

Lower Bari Doab Colony.

	1922.	1921.	Increase (+) or Decrease (−)
	Acres.	*Acres.*	
American cottons	162,027	185,220	−12·5 %
Desi cottons ...	34,562	19,082	+81·1 %
Total	196,589	204,302	−3·3 %

From these figures it is seen that the fall in the area under Americans was serious, being almost 40 per cent in the Lyallpur Colony. Desis increased by practically 80 per cent over the whole circle while the total area under cotton was somewhat lower than the previous year throughout the circle.

The seed purchased for sale this year was as follows :—

	Lower Bari Doab Colony.	Lower Chenab Colony.	Total.
	Mds.	*Mds.*	*Mds.*
4-F American	2,811	3,724	6,535
285-F American	801	227	1,028
Mollisoni Desi	750	715	1,465
Total ..	4,362	4,666	9,028

Seed was bought early in the season and owing to the American crop having done well there was a keen demand for our seed as sowing time approached. In both colonies all the 4-F seed was quickly sold out and had it then been possible for us to secure more good seed much more could have been sold. The seed being offered us towards the end of the season was, however, of very indifferent quality and could not be purchased. In the Montgomery Colony the demand for 285-F seed was equally keen but more good seed was not available to us. In the Lyallpur District, demand for the 285-F variety has not been very keen so far and a small quantity of the seed available remained unsold. For the Mollisoni seed the demand was fair but was not so much as was expected, as the whole trend of public opinion was for American cottons.

The average cultivator is inclined to rush blindly for whatever happens to have done best in the previous year irrespective of the quality of his land or his water-supply. He is advised not to sow American cotton at all where his land is poor or his irrigation supply precarious. In spite of this the temptation of the high yield this year coupled with a premium of at least Rs. 8 per maund for the American over the Desi varieties has in many cases proved too much and where American seed could be had at all, even it were only bazar seed of poor quality he has sown American and taken his chance. The area under Americans has therefore in the present growing crop gone up enormously.

In the Lower Bari Doab Colony, American 285-F cotton was generally more favoured on the Lahore side of Montgomery whilst towards its Multan side 4-F was considered the better. The yields obtained by some of the chief growers were as follows :—

	Average outturn per acre.	
	285-F.	4-F.
	Mds. Srs.	Mds. Srs.
Raewind Demonstration Farm ...	9 28	9 24
Coleyana Estate	9 33	10 1
Military Farm, Okara	9 2	8 20
Convillepur Estate	8 0	7 20
Seed Farm, Montgomery... ...	10 25	...
Chak 89/6-R. Co-operative Demonstration Farm.	12 38	13 20
Iqbalnagar Estate	3 10	6 0
Sardar Jagat Singh 145/9-L. ...	10 0	11 20
Sardar Jagat Singh Pirawala ...	5 20	7 10
British Cotton Growing Association Estate, Khanewal.	9 36	12 23
Jahangirabad Farm	8 0	9 0

In the Lyallpur Colony very little 285-F has so far been grown. Those who have grown it are more in favour of 4-F. This year comparisons of the two are being done on a wider scale.

Those of the growers who had 285-F cotton on a large scale were able to get a premium of about Rs. 2 per maund of Kapas over the 4-F

variety but in places where the quantity offered for sale was small no premium was given though the buyers acknowledged that the lint was of superior quality.

Desi cottons were on the whole fair but the difference in price in favour of American cottons this year—Rs. 8 to Rs. 9,—accompanied by a good yield in the latter put Desi much out of favour in this circle. This will be reflected in the lower acreage under it during the coming year.

The area of cotton sown in lines continues to increase and the demand for assistance is constant and heavy during the sowing season.

Cotton auctions.—It was arranged to hold four auctions for American cotton during the season, two at Lyallpur and two at Jaranwala. The intention was mainly so that we might purchase the seed for next year's sowing. Of the four auctions two had to be cancelled owing to rain on the day before the sales, so that eventually only one sale was held at each centre. At the Jaranwala auction slightly over 6,000 maunds of 4-F cotton were put up for sale and disposed of, the prices received being slightly in excess of the Mandi price. From this sale we secured 1,125 maunds of good seed. At the Lyallpur sale only 1,100 maunds of cotton both American and Desi (Mollisoni) were offered and as the lots were small the buyers would not give even Mandi rates until we released the seed. Accordingly we got no seed from this sale. From the point of view of our securing good seed these auctions were more or less a failure. No auctions were held in the Montgomery District as the growers were emphatic at the meeting of the Agricultural Association that auctions were no longer required. One sale was held at Renala Khurd under the auspices of the Fauji Zemindars Association. The quantities offered were not large but the prices obtained were good. My staff assisted at this sale by classifying the various lots.

After thoroughly studying the matter, I am of opinion, that for the present these auctions might be discontinued. Buyers are all giving a good premium for American cotton and the Punjab market for it is firmly established. Sales now organised by the Agricultural Department bring only small quantities for disposal and the price obtained at the sales is practically nothing in excess of local Mandi rates. If it appears later that the growers are not getting the prices prevailing elsewhere for their produce the auctions could be resumed. From the point of view of our obtaining good seed for distribution we can obtain all our requirements from the various Government grantees in this circle.

Cotton prices telegrams.—It has been the custom during the last few years to obtain daily from Bombay, during the cotton season, the prices ruling for American cottons. This information is wired to the principal cotton markets in this circle and after being converted into what should be the local price by deducting freight, ginning charges, etc., is posted on our Notice Board in the Mandi. This practice was continued during the preseut year but did not serve the same useful purpose that it did previously owing to the fact that buyers were

paying a premium over Bombay figures. The rates actually prevailing in the various Mandis throughout the season were some Rs. 2 per maund more than the Bombay rate reduced to local terms.

Wheat.—The weather during December, January and February was dull and cloudy and greatly favoured the attack of rust which began to appear in early December all over the colonies. In March some damage was done to wheats in the Lower Chenab Colony by a severe hailstorm but this was only local. Finally in May when the wheat crop was either on the threshing floor or in heaps awaiting threshing very heavy rains fell and entirely spoiled the quality of the grain much of which began to germinate. These factors therefore severely affected both the outturn and quality of the crop which is, in consequence, lower than normal.

In this circle the following quantities of good seed were purchased for distribution during the year—

				Maunds.
Punjab 11	...	...	...	7,950
Punjab 8-A	...	...	...	1,152

Out of this all the 8-A variety was sold for seed, but only some 2,700 maunds of the Punjab 11 variety could be so disposed of and the remainder was sold in the market. The previous wheat crop had been good and growers held over large stocks of seed till sowing time in the hope that prices would rise. The demand for our seed was in consequence small. Throughout the canal colonies of which this circle is composed Punjab 11 wheat is now everywhere. Indeed it may be said that in various degrees of purity it forms almost the whole of the wheat crop.

Punjab 8-A has been gaining steadily in popularity particularly in the Lower Bari Doab Colony. All the seed which we had bought for distribution was rapidly sold out and we have arranged to provide it in much large quantity during the coming rabi to those desirous of sowing it. In the district this variety was grown by several cultivators in comparison with Punjab 11 and is well reported on. The figures given by these show a difference in favour of Punjab 8-A varying from 2 to 4 maunds and averaging about 2½ maunds of grain.

In the Multan, Muzaffargarh and Dera Ghazi Khan Districts, in the last two of which work has only been started this year, 1,533 acres of pure Punjab 11 and 80 acres of Punjab 8-A and 17 were grown a very good record for the first year. The wheats grown there are mainly of the beardless types but the bearded types introduced this year were favourably reported on.

Implements and Machinery.—A statement is attached giving as far as possible the statistics of the various implements sold during the years. The number of reapers is small, due to their continued high price. The Rajah machine stood at Rs. 575 which is much too high to attract purchasers. On the Lyallpur farm we have been trying other makes of reapers which are being offered at a much lower figure and we hope shortly to be able to recommend these to intending purchasers. The

Rajah fodder-cutter still continues to be popular in spite of its high price. A good many fodder-cutters of another make—the Simplex—have been sold in this circle recently. The fodder-cutter is probably the most popular machine with the zamindars and the Simplex is offered at some Rs. 40 less than the Rajah. Hence although it may not be so strong a machine it attracts those wanting a chaff-cutter. It is interesting to note that two local blacksmiths in a Chak in this district, realising the keenness in demand for fodder-cutters have started to manufacture some and are reported to have sold 22 machines so far. We have had some enquiries from large cultivators in the districts as to bullock-driven chaff-cutters. Recently we have received one on trial from a Firm who imports them. It appears to do very good work. Its price is Rs. 725 and it cuts on the average 30 maunds green fodder per hour. The Chatanooga plough is a new introduction to this district and owing to its cheapness in comparison with the furrow-turning ploughs already on the market here has found favour with a good many zemindars. It is unfortunate that just when it was being purchased in fair numbers the makers should have found it necessary to increase its price.

The stock of horse hoes we imported was very quickly sold out, in-spite of the high figure at which they are still selling. More could have been sold had they been available.

Of our own manufactured implements Bar harrows and sowing drills continue to sell in fair numbers. During the year a new automatic seed drill for wheat was designed and made at Lyallpur. It works on the principle of the large drills, *viz.*, by cups in a seed box delivering a fixed and regular supply of seed to exit pipes. It sows four rows at a time and is capable of drilling from a half to three-quarters acre per hour. A few have been supplied to selected zemindars and others for trial. Another machine has been designed for the separation of bhusa and grain after threshing with bullocks. If finally successful it should be a popular machine as much difficulty is often experienced in the harvesting season in winnowing the grain owing to absence of sufficient wind.

In this circle there are now at least a dozen tractors of various makes. The owners of all have been from time to time visited and their difficulties and experiences discussed in the light of our own work on these machines at Lyallpur.

Agricultural Associations.—Each of the two colonies in this circle has its own Association and two meetings of each were held during the year. The attendance at, and interest taken in, the meetings of the Lower Bari Doab Association is always exceptionally good. The Lower Chenab Association meetings are not attended so well as they might be. At the meetings papers are contributed by members on the subjects in which they are specially interested and informed, and by members of the staff on the work of the Agricultural Department. At Lyallpur demonstrations are given of new machinery and implements, stock, etc. At both the meetings at Lyallpur during the past year the Entomologist to Government or a member of his staff have given useful and instructive lantern lectures on crop pests. We are indebted to him for these and take this opportunity of thanking him.

Practical classes.—Two classes were arranged as usual but for one no applications were received. The winter class was attended by 6 persons. Offers were made at an Agricultural Association meeting, at Montgomery to hold a practical class for instruction in reaping machines, but owing to the high price of the machines there were no intending purchasers and consequently no demand for a class.

Demonstrations and exhibitions.—It has now become a special feature of our propaganda work to have a tent at the annual fairs in all the main towns in the circle where improved seeds, implements, etc., are on view and where advice is given to all enquirers. In addition practical demonstrations with implements are held and leaflets distributed widely. During the past year such demonstrations were given at the annual fairs in the following towns :— Sheikhupura, Jhang, Lyallpur, Multan, Dera Ghazi Khan, Sakhi Sarwar, Kasur, Pattoki, Okara, Montgomery and Khanewal. Besides these itinerary demonstrations are given in villages all over the district. At the Lyallpur fair a special practical exhibition is annually given at the farm of all the latest implements, machines, and any other improvements.

Leaflets and publications.—Those desirous of obtaining our latest information on machinery and other investigations during the year are referred to a leaflet issued recently on the subject of tractors and tractor cultivation. Fuller particulars can, if desired, be found in the Agricultural Journal of India of January 1923. In the same Journal will also shortly appear an account of work done and results obtained with threshing machines and reaping machines and on improved furnaces for the country manufacture of gur. Contributions have also been sent to, and appeared from time to time in the Implement and Machinery Review.

Acknowledgments.—I desire to thank B. H. Dobson, Esquire, C.B.E., I.C.S., and F. H. Puckle, Esquire, I.C.S., for their interest in the Agricultural Associations at Lyallpur and Montgomery respectively. I am specially grateful to W. Roberts, Esquire, British Cotton Growing Association, Khanewal, for his unfailing help in supplying us with pure seeds. His estate has been fortunate in many respects climatically during the year and he has given us of his carefully selected produce unstintingly.

I take this opportunity of acknowledging my indebtedness to my whole staff for the cordial support they have one and all given in their various spheres of activity whether of an executive or clerical nature.

H. R. STEWART,

Professor of Agriculture, Punjab, Lyallpur.

Statement showing sale in the Lyallpur Circle of Improved Agricultural Implements during the year ending June 30th 1923.

Imported implements.		Implements manufactured by the Punjab Agricultural Department.		Implements manufactured in India.	
Name of Implements.	No. sold.	Name of Implements.	No. sold.	Name of Implements.	No. sold.
Rajah Plough	21	Bar Harrows	182	Meston Plough made in Punjab	69
Meston Plough	94	Drills	266	Sardar Ploughs (Bombay) ...	3
Horse Hoes	46	Lyallpur Hoes	31	Nahan Sugar-cane Crushing Mills	302
Rajah Reapers	4	Drag Harrow	1	Kaisar-i-Hind Bullock Power Flour Mills.	2
Rajah Fodder-cutters	159	Miscellaneous articles	426	Kirlaskar Chaff-cutter (Bombay)	1
Simplex Fodder-cutters	29			Hathi Cane crushing Mills by Burn and Co.	2
Imported shares for imported ploughs (all parts).	128			Ratala Cane crushing Mills about	200
Grinding Mill No. 2	1			Shares	10
Punjab Ploughs	4				
Chatannooga Ploughs	100				
Chatannooga Cane Mill	1				
Peg toothed Harrow	7				
Cultivators Nos. 53 and 55 by International Harvesting Co.	7				
Other Fodder-cutters	5				
Bullock Gear Fodder-cutter	3				

Note.—One Firm did not even after repeated reminders supply us with a list of implements supplied by them in this circle. The list supplied by them is for the whole Province. The number of Meston Ploughs, Rajah Ploughs and Simplex Chaff-cutters has been taken from office records and reports from Agricultural Assistants and could not be compared with the list.

H. R. STEWART,
Professor of Agriculture, Punjab, Lyallpur.

APPENDIX VII.

Annual Report of the Deputy Director of Agriculture, 1st Circle, Gurdaspur, on district work for the year ending 30th June 1923.

This Agricultural Circle comprises 16 districts out of a total of 29 in the province and has been sub-divided into 2 divisions each in charge of an Extra Assistant Director of Agriculture, for district work under my supervision. Owing to insufficiency of the trained staff, however, work on an extensive scale has been possible only in Hoshiarpur, Jullundur, Amritsar, Gurdaspur, Sialkot, the Lower and Upper Jhelum Colonies and the barani portions of Gujrat and Shahpur Districts. Demonstrations, seed supply and other general propaganda have also been done in Ludhiana, Lahore, Gujranwala, Jhelum, Rawalpindi, Campbellpur, and Mianwali. There are 13 farms, *viz.*—

1. Government Experimental and Seed Farms —

Gurdaspur	...	Experimental.
Sargodha	...	Ditto and Seed Farm.
Chillianwala	...	Seed Farm.
Kala Shah Kaku		Rice Farm.
Beas	...	Demonstration Farm.

2. District Board Demonstration Farms :—

Ludhiana.
Jullundur.
Sialkot.
Gujrat.

3. Private institutions :—

Khalsa College farm at Amritsar.
Borstal Jail Farm at Lahore.

4. Zemindara Farms :—

Sardarpur and Kot Fazal Ahmed Farms in Shahpur District.

The two Extra Assistant Directors of Agriculture remained incharge of the district work in their sub-circles but all the farms in the entire circle were kept directly under my own supervision. This policy relieves Extra Assistant Director of Agriculture of all unnecessary obstacles and enables whole time devotion of his attention to the district work, which is the legitimate duty for such an officer. He is, therefore, in a position to control more closely and efficiently the movements of his staff and the methods adopted for propaganda and is enabled to come in direct and frequent contact with the Zemindars in his circle.

Methods for the district propaganda were similar to those adopted last year and are as follows :—

(1) Demonstration plots.
(2) Private demonstration farms.
(3) Concentration in selected villages.

(4) Demonstration and sale of improved and pure seeds and implements.

(5) Maintenance of machinery and seed depôts.

(6) Cotton auctions.

(7) Cultural experiments with potatoes at Jullundur and Sialkot.

(8) Agricultural Associations.

(9) Demonstration of the modified Meglashan furnaces.

(10) General propaganda work, *e.g.*, sowing in lines, interculture, exhibitions and demonstrations at Horse and Cattle fairs, and other public functions.

Below is given a brief description of the general progress achieved in each sub-division of the circle separately.

1.—Sargodha Division.

M. Mukhtar Nabi, Extra Assistant Director of Agriculture, Gurdaspur, held joint charge of both sub-circles till 18th December 1922, when he was relieved by Ch. Gurdial Singh transferred from Kahuta. Although this circle includes the whole of the North Punjab the main activities of the Department are limited to Gujrat and Shahpur Districts. There are only 5 Agricutural Assistants on district work and for convenience have been stationed to work as follows :—

Sargodha	Incharge of the district work in Sargodha Tahsil.
Bhalwal	Incharge of the district work in Bhalwal Tahsil.
Shahpur	Incharge of the district work in Shahpur and Khushab Tahsils.
Gujrat	Incharge of the barani area of Gujrat District, *i.e.*, Gujrat and Kharian Tabsils.
Chillianwala	Incharge of the canal irrigated area of Gujrat District, *i.e.*, Phalia Tahsil.

Season.—The rainfall statement attached shows a record of the precipitation at different stations in the division. Being above normal with proper distribution, it was exceptionally favourable to Toria and Cotton this year. For the Rabi, however, it was particularly harmful, as besides rendering the wheats late it stimulated and fostered the rust and smut fungi both of which waged a virulent war on this crop. Hailstones also fell but worst of all was the rain during harvesting and threshing operations which dashed all hopes of the growers to such a degree that even availability of the next year's seed has been rendered doubtful.

Wheats.—With favourable weather conditions the sowing of wheats was done in its proper time, though owing to Canal vagaries some difficulty was felt in canal areas of the circle and less area was sown than anticipated. Germination was satisfactory but following

the copious rains which followed and continuous wet weather produced excessive vegetative growth (except in tracts which were fortunate in having less rain) and the rust and smut fungi became so widely prevalent that fields with 20-30 per cent. affected plants were not uncommon. Local hailstones in March and April practically destroyed the crop on which the hail fell. Owing to the rains the wheat advanced to maturity very slowly but had to hasten during the spell of high temperatures in early April resulting in shrivelled grains. The last calamity that befell the crop was the severe windstorm and rain on 13th May catching the grains in the open threshing floors and destroying their colour and keeping qualities. This and the aggregate of other calamities this year has been estimated to have caused a reduction of about 20 per cent. in the total outturn of wheat crop.

Punjab 11 and 8-A are still the premier wheats in the colonies as well as the barani areas of the districts. Trials at Sargodha farm described separately show a very close competition though on the whole decide in favour of 8-A as the heavier yielding variety of the two. 8-A when first introduced possessed bright amber colour hard grains with good keeping qualities and was especially liked for eating purposes and as such it was in every way superior to Punjab 11. As observed last year 8-A has again this year produced mottled grains yet it retains its high yielding capacity. Amber coloured grains generally fetch a higher price in the market than mottled or white wheats and it remains to be seen which of the Punjab 11 and 8-A becomes a financially superior variety.

Until a better type is forthcoming 8-A is being widely recommended. It has now outgrown all estimates of the areas covered and as stated last year there were in all about 12,000 Mds. of 8-A seed available in the lower Jhelum Colony, of which some 10,000 Mds. were used for seed during the Rabi 1921-22 covering about 21,000 acres. This year some 6,610 Mds. of selected seed of 8-A were stored by the Department in its various seed depôts (Sargodha Division) but only 1,567 Mds. could be disposed of as seed, the reason being that the cultivators still possessed their own produce which they had stocked in the hope of prices rising at the sowing time. However the object of using 8-A for seed on as large a proportion of the total wheat area as possible was more than fulfilled and nothing short of 40 per cent. of the total area in the Lower Jhelum Colony can now be safely taken to be under 8-A. In the Upper Jhelum Colony the area under 8-A is still very small as it was introduced there only 2 years ago. This season 425 Mds. of the variety were sold in that colony and 213 Mds. in the barani tract of Gujrat District.

Cotton.—Under favourable conditions the germination of the last crop was completed without interruption. July & August brought a good deal of rain to help the crop in its vegetative growth and September and October were sufficiently wet to avoid all risks of a failure. The American cotton was therefore fortunate in every respect and did much to regain its lost prestige. With previous adverse experience its area had been considerably reduced but with the success and high prices prevalent this year its kapas was much sought

after by factory owners, and the entire produce was consumed in a very short time. Such a keen demand and a premium of about Rs. 5 to Rs. 7 per maund over Desi gave a fresh impetus to growers and there was an unprecedented heavy call for its seed for the new standing crop. The Department had with great difficulty secured 5,202 Mds. for pure 4-F seed (which was all that was available) and 84 Mds. of the pure strains of Sanguinum and Mollisonia Desi varieties stored at its various depôts. Although 4-F seed was 1,680 Mds. more than the quantity stored last year it was all disposed of within a fortnight of starting the sale. The demands and indents for more seed were still persistent and widespread but unfortunately no help could be rendered and the zamindars had to fall back on the bazar seed. The increase in sown area under 4-F in the year under report is on an average of the whole colony nearly 25 %. Soon after the crop was sown rains followed in April and May and produced incrustation preventing germination. Resowing was necessitated but this too showed a similar fate and a 3rd sowing was done. In places fields had to remain unsown for unavailability of seed. The Departmental selected seed sown in the first instance was in many places destroyed and had to be substituted with whatever could be got from the bazar. A great difficulty is therefore anticipated in finding pure seed of 4-F next year.

The following shows approximate areas for both 4-F American and pure strains of Desi varieties :—

	Kharif 1922.	*Kharif* 1923.
4-F American ...	84,455	... 90,126
Pure Desi ...	30,720	... 27,521

285-F newly introduced in the Lower Jhelum Colony seems to have done well in the Lower Bari Doab Colony. But the yields were lower than 4-F at both the Sargodha and Chillianwala farms. Experience has shown, however, that the lines were sown too far apart for this particular variety. With zamindars, too, except in one Chak, 285-F did not compete with 4-F.

Sowing of cotton in lines.—This has become extremely popular and the demand to demonstrate the method of sowing was so great that the limited staff was unable to attend in all directions. Some 10,000 acres of the standing crop have been sown in lines under the direct supervision of the staff but this is only a minor portion of the total area sown in lines by the cultivators themselves. Instances have been noticed when crop was discovered in lines of which there was no intimation and therefore no correct estimate can be formed. A line sown crop receiving adequate interculture gives on the average 1 to 2 Mds. of kapas per acre more than the broadcast in a normal year and thus even the 10,000 acres will give at least 10,000 Mds. of extra kapas which at Rs. 15 per maund fetches Rs. 1,50,000 extra profit to the colony. The value of such an activity is therefore beyond doubt.

Cotton Auctions.—Such sales were of immense benefit in the first 3 or 4 years but with the spread of areas under pure American cotton and the high prices easily obtainable almost everywhere now they have of late failed to fulfil their objects and have rather become cumbersome perfor-

mance for the Agricultural Department. Advisability of limiting them to particular places is therefore being considered and it is proposed to hold only 3 auctions, two at Sargodha and Baha-ud-Din, the centres cotton trade in Lower and Upper Jhelum Colonies, and one at Tarn Taran where American cotton has just been introduced.

In stopping the auctions, altogether one difficulty will arise, namely the source of securing guaranteed seed. This can, however, be arranged now without trouble in the Lower and Upper Jhelum Colonies where, through efforts of the Department, the large landlords are now alive to the advisability of using pure seeds and having thousands of acres under such pure crops. Only 2 auctions could be held during the year under report. The quantities of the kapas brought to the auctions together with the classification and prices have been given in the statement attached. At Sargodha in addition to 3,958 Mds. of kapas sold on the spot 600 Mds. were sold on sample, fetching a commission of Rs. 119-4-0 to the Department.

Sale of implements.—The number of implements sold this year is as below :—

	1920-21	1921-22.	1922-23.
Meston Ploughs ... Duncan Stratton ...	107	130	152
Meston Ploughs ... Burn and Company	...	...	2
Meston Ploughs ... Batala ...	...	...	30
Meston Ploughs ... Local manufacture ...	...	...	30
			214
Hossier 8 × 8 Disc. drill	...	...	1
Raja Plough	31	6	17+18=35
Chatta Nooga Plough	...	...	13
Punjab Plough	...	...	...
Spring tined Harrow	1	...	5
Planet Junior Hoe	...	...	...
Raja Fodder cutter	1	1	1+1=2
Bar Harrow	48	14	23
Raja Reaper	...	1	...
Crushing Mills (Batala and others) ...	...	...	6
Drills	4	3	...
International Disc. Harrow	...	...	2

"Ploughs" are therefore more in demand than any other implement and the numbers sold are greater for the cheaper ploughs like the Meston than the Raja or the Punjab. The Meston is a universally

popular plough chiefly on account of its low price and comparatively easy draft. It is being put on market by various big Firms but of late some local foundries and village smiths have also taken to their manufacture and the result of such competitions and consequent reduction in price for the benefit of the petty cultivators is very great indeed.

Free loan of implements.—This system was very vigorously continued and has proved most useful in furthering the sales. The following implements were given out on free trial :—

Nalia for cotton sowing and the marker.	120	Rabi drills ...	6
Raja Ploughs ...	23	Planet Junior Hoes ...	6
Meston Ploughs ...	23	Spring toothed Harrows	7
Bar Harows ...	13	Hand Hoe ...	1
Lyallpur Hoes ...	6		

The Raja and Punjab Ploughs are especially liked but high prices often form a formidable barrier to their sale which is therefore rather slow. Another reason for their slow introduction is found in the fact that a good proportion of the areas is under large landlords who cultivate their estates through tenants. The latter are naturally shy in incurring any extra expenditure in the shape of new implements and unless the landlord himself happens to be specially interested all inducements are ineffective. Action of one such landlord, Lieutenant Malik Sardar Khan of Shahpur District, in distributing a number of Meston Ploughs amongst his tenants and advancing half the cost of each plough himself is very commendable and it is hoped others will now be induced to follow suit.

Credit sale of Ploughs.—With the inception of Departmental activities the implements to be popularized were first given out for free trial and then sold on credit, but an immense amount of trouble was ultimately experienced in recovering such long outstanding dues. Credit sale had therefore to be stopped altogether and transactions were done on cash payment only. This hit petty cultivators especially in the Barani portion of Gujrat District who desired to purchase Meston Ploughs but had to defer it for want of ready cash. To overcome this the help of local Co-operative Societies was sought and a system of credit sales has been introduced. The implements chiefly Meston Ploughs are supplied by the Agricultural Department either from its own Machinery Depôt or ordered direct from the Firms to the Central and Union Banks which then distribute to their members through the various societies on credit. No trouble in recovering the prices of the implements sold is feared as the Bank concerned stands a surety for each individual society and will pay to the Agricultural Department in instalments say every six months. This arrangements has been completed in case of two villages Chak Mubarik and Changanwali and others are being arranged for.

Machinery Depôts.—Bhalwal has been added to the already existing 3 Branch Depôts at Gujrat, Chillianwala and Sarghoda. Mostly Meston Ploughs and their shares that are in general demand are stocked. For other implements when required reference is made to the principal

depôt at Gurdaspur, which if unable to supply immediately places the order with the Firm. Thus immediate supply of implements and their parts has been ensured.

Demonstration of Implements.—The practice has been to fix a day with the head of a village where demonstration of implements is desired. All villagers assemble and inspect and scrutinize the implements worked. If desired one or more of these implements is left with interested visitors for a few days for their own trial and opinion. With the location of the head-quarters of the Agricultural Assistants at suitable centres and their jurisdictions being restricted to one or at the utmost two tahsils such demonstrations have been numerous this year. Each Assistant has been supplied with a pair of bullocks and a cart with a set of demonstration implements and this equipment has since been fully justified.

At Sargodha during the horse and cattle fair elaborate arrangements for ploughing matches, poultry shows and Agricultural produce exhibition were made and through the liberality of the Shahpur District Board prizes to the sum of Rs. 800 were distributed. On special request from Deputy Commissioners, Jhelum and Mianwali, a demonstration extending over a week was also given at Chakwal and Mianwali on the occasion of their Cattle and Horse fair.

Seed Depôts.—There are 15 seed depôts in the Sargodha Circle now. To increase their number in the Barani portion of the Gujrat District 3 new places, *e. g.*, Kunjah, Jalalpur Jattan and Pero Shah have already been selected. Scattered and diffused amongst the villages such depôts lie whithin easy access of the zamindars in the locality and therefore distribution of selected seed is facilitated.

Demonstration Plots.—In the Canal Colonies no such "demonstration plots" as in vogue in the central districts of the Gurdaspur sub-circle are needed. But a start has recently been made in the Barani tract of Gujrat District where 7 plots were arranged; 5 cultural and 2 varietal. Although in two the crop had been seriously damaged by rats, others show superiority of 8-A seed and Raja and Meston Ploughs compared to the Desi *hal*. The work is being extended.

Concentration Villages.—This a new method of work started during the year under report. A few villages which enjoy full confidence of the Agricultural Department and are inclined to seek advice and act accordingly have been selected for more concentrated attention by the Department. Every possible assistance is rendered in the way of Implements, Seeds, Demonstration, etc., with a view to convert them into model villages in the locality, but this does not by any means preclude Agricultural Assistants rendering the ordinary assistance elsewhere. Four such villages have been selected in the circle of each Agricultural Assistant and work is in progress satisfactorily but it is yet too early to be brought under discussion.

The Farms.—There are 3 Farms in this division—two Government Farms at Sargodha and Chillianwala and one District Board Farm at Gujrat. In addition there are 2 private Zamindara Farms at Sardarpur

and Kot Fazl Ahmad in the Shahpur District. For the experimental and seed farm at Sargodha a separate report has been submitted.

Chillianwala Seed Farm.—This consists of 10 rectangles, situated in the heart of Upper Jhelum Colony at a distance of about a mile from the Chillianwala Railway Station. 1½ rectangles are under the direct cultivation by the Department and the rest is being farmed by tenants on half batai system. As it is essentially a seed farm no experiments are being conducted beyond the environment tests for new varieties of crops when first introduced. 4-F cotton and 8-A wheat are sown on a large scale for seed but this year some pure strains of the desi cotton were also introduced. 285-F American cotton was also grown on a large scale, but failed to give satisfactory outturn, hence sufficient seed for next year's sowing only had been reserved. The farm site was originally "Bar" land overgrown with scrab which has been gradually removed, but there are portions of it still standing. Levelling was kept up during the year. Buildings are still badly wanted, and the two pucca seed godowns being insufficient to hold the farm produce, one more godown, the Manager's quarter, his Office, and an implement shed are of immediate requirements. The old temporary mud buildings for the bullocks and tenants had become dilapidated and involved a risk of sudden collapse, but with the grant of Rs. 1,200 they have all been thoroughly repaired. In addition to supply large quantities of 4-F cotton and 8-A wheat seeds this farm forms the nucleus of the district work in the Upper Jhelum Colony. A machinery depôt has been opened and maintained. The following were the income and the expenditure during the year:—

Income—

	Rs.	A.	P.
Sale proceeds	10,813	2	3
40 Mds. 11 seers of gram in store at Rs. 2-12-0 per Md.	110	12	0
460 Mds. of wheat in store at Rs. 4 per Md.	1,840	4	0
Total ...	12,764	2	3

Expenditure—

Actual (including the pay of beldars employed)	3,690	8	10
Extraordinary (special grant for the repair of farm building) ...	1,193	0	6
Total ...	4,883	9	4
	12,764	2	3
	4,883	9	4
Net Profit ...	7,880	8	11

Gujrat District Board Farm.—A small farm of about 50 acres partly barani and partly irrigated by a well is financed by the local District Board and is run by the Agricultural Department. The soil

throughout is underlaid with a stratum of pure sand at varying distances of 1—4 feet from the ground level and is totally deficient in organic matter. Considerable reclamation and green manuring has therefore to be done. It has been laid out in 4 convenient blocks sub-divided into plots of one acre each and reclamation commenced last year was maintained during this year. Under such circumstances no experiments can be possible and so far wheat was the main crop, and the farm has been naturally run at a considerable loss. Of late a somewhat intensive scheme introducing vegetable crops has been inaugurated and for all practical purposes it looked as if this year's financial results would turn the scale. But as ill luck would have it unfavourable weather set in and although the margin of loss this year is very small compared with that of previous year the farm could not pay its way.

Poverty of the soil with late rains in kharif and excessive rains during rabi destroyed 5½ acres of gram altogether and reduced the outturn of wheat. This was followed by a great drop in price and was chiefly responsible for bringing about the loss. The crop of Taramira was in an excellent condition till the fruiting stage and like bajra and other chari fodders was ultimately rendered inferior both in quality and outturn, water melons expected to fetch at least Rs. 200 could only bring Rs. 13-12-3. Despite these calamities the loss this year was only Rs. 300 compared with Rs. 922-13-0 last year and Rs. 1,005 the year before. From this it is evident that although the farm has to incur extra expenditure in reclaiming the land (which has already greatly increased in its market value) it is making satisfactory progress towards its annual income. The following shows the income and expenditure figures this year:—

Income—

	Rs.	A.	P.
Sale proceeds	1,131	15	0
Inter-Departmental charges (between the Farm and District Board garden at Gujrat)	20	0	0
Outstanding (all recoverable) ...	344	14	3
Estimated price of grains in store ...	60	0	0
Price of melons	15	0	0
Total ...	1,571	13	3

Expenditure—

	Rs.	A.	P.
Ordinary expenditure (including pay of beldars).	1,270	9	3
Price of gram for bullocks	323	5	9
Price of farm-yard manure for reclamation purposes.	180	0	0
Land Revenue	95	8	0
Total ...	1,869	7	0

Private Farmers : Sardarpur.—This enterprise is of comparatively recent origin and aims at tackling the large landlords who hitherto have remained indifferent in the improvement of their estates. For petty cultivators "Demonstration plots" are answering the purpose for large landlords opening a number of such private ferms will arouse interest which once started will rapidly spread over the rest of their estate. As an experiment on such farm was opened two years ago with Lieutenant Malik Sardar Khan of Shahpur in his village Sardarpur. The farm has made good progress, and I am glad to say has already had a marked effect not only in that particular village, but also within a radious of 10 miles round. The owner deserves every credit for having recently distributed 25 Meston Ploughs amongst his tenants meeting half the cost himself. This is an excellent example and I note with pleasure that his neighbours are also following suit. The farm besides demonstrating the use of implements, seeds, line sowing, interculture, etc., has been able to provide the Department with seeds of pure Desi cotton varieties, and 8-A for further distribution and at the same time has fetched a handsome profit to the owner as follows :—

	Rs.	A.	P.
Income	1,472	14	9
Expenditure	604	7	0
Net profit	868	7	9

Encouraged with these results the owner has now employed a wholetime Mukaddam of his own, and has become a keen follower of the Department.

The result of this experiment was discussed in Agricultural Associations of different Districts, and it is very gratifying to note that applications for opening such farms have become numerous. Unfortunately owing to lack of staff not more than 2 or 3 can be undertaken at present, and 2 new ones (one in each of Shahpur and Gurdaspur Districts) have already been opened and a 3rd one is still under negotiations, the results of which will be incorporated in the next report.

II.—Gurdaspur Division.

M. Mukhtar Nabi, Extra Assistant Director of Agriculture, held charge of this division throughout the year. It comprises 7 districts in all, of which, except, Ludhiana and Gujranwala work on a very extensive scale is in progress. Each district has one Agricultural Assistant except Gurdaspur where the number has been recently increased to two. The lines of general propaganda are similar to those mentioned in the Sargodha Division.

Demonstration plots.—This is the outstanding feature of work in this sub-circle dealing chiefly with petty cultivators of which the central districts are composed. Such plots are of two kinds (*i*) cultural where use of improved implements and methods of cultivation are demonstrated and (*ii*) varietal where improved crop types like wheat,

cane, etc., are grown side by side with the local types for comparison. The field for a Demonstration plot is divided into two halves ; care being taken to avoid as far as possible variations of the soil, and the entire work is done by the particular zamindar himself directly under the advice of the Agricultural Assistant or his Mukaddam. The number of plots managed this year was as follows :—

	1921-22	1922-23.
Gurdaspur	40	28
Sialkot	31	61
Jullundur and Hoshiarpur	19	80
Amritsar	Work newly started.	

In Gurdaspur some plots were 4-5 years old and were given up by the Department last year in order to see if the owners could continue to practise what they had learnt during that time. In other districts they are of recent origin. Statement embodying the results obtained has been attached.

Demonstration and sale of improved implements.—Each Agricultural Assistant on district work has been provided with a pair of bullocks, a cart and a set of implements for demonstration and the itinerary system of implements was therefore more vigorous this year in addition to the organised demonstrations at :—

(1) Sialkot ... At Cattle fairs at Sialkot, Throh, Narowal and Koreki.

(2) Gujranwala ... At the anniversary of the Co-operative Central Bank where Agricultural Exhibitions and Entomological slides were also shown.

(3) Amritsar ... At Amavas mela of Tarn Taran.

(4) Jullundur ... At Cattle fair an elaborate Agricultural Entomological and Botanical Exhibition was held.

(5) Hoshiarpur ... At the local cattle fair.

The following implements were sold in this Division :—

		1921-22.	1922-23.
Meston Ploughs ...	Duncan Stratton	1,287	123
	Batala Improved, Ch	...	261
	Local manufacture including Burn, Calcutta and others of Batala, Nurmahal and Phagwara in the Punjab.	...	1,240
			Total ... 1,624

—	1921-22.	1922-23.
Raja Ploughs	6	3
Punjab Ploughs	...	2
Raja Fodder Cutters	1	5
Planet Junior Horse Hoes	...	...
Spring tined Harrows	...	2
Bar Harrows	5	13
Simplex Chaff Cutters	...	13
Drills	...	2
Hand hoe	...	1
Crushing Mills from Batala (through Department) ...	...	22

Concentration of attention in selected villages.—Like the Sargodha sub-circle here also vigorous efforts are being concentrated in villages more inclined to seek Departmental advice and since the start of such operations hardly a year ago considerable progress has been made as shown in the statement attached.

Credit sale of implements.—This system has been outlined under the Sargodha report. Similar arrangements are in progress here also.

Seed and Machinery Depôts.—For the convenience of the zamindars these depôts were maintained in all districts for distribution of seed and ploughs. The machinery depôts chiefly stock Meston Ploughs (Duncan Stratton and Batala) and their spare parts and are situated at the following places :—

(*i*) Gurdaspur principal depôt,

(*ii*) Sub depôts at Sialkot, Tarn Taran, Beas, Jullundur, and Hoshiarpur.

The seed depôts opened in all the districts have stocked and sold chiefly 8-A wheat seed and are being greatly appreciated by the public.

Similar methods as in the Sargodha division in selecting, roguing and purchasing and storing 8-A seed are practised. This year Rs. 60,800 were allotted out of which Rs. 51,880-3-6 were actually spent securing 8,338 maunds 36 seers at rates ranging between Rs. 6 to Rs. 6-13-0 per maund. After the purchase was made the prices began to fall till in autumn they were considerably low and therefore the whole stock had to be sold at Rs. 4 to Rs. 5-8-0 per maund, less than the cost price resulting in a total loss of Rs. 14,869-3-9 for the wheat transaction. Cotton seed on the other hand fetched a net profit of Rs. 1,945-10-9.

Owing to adverse weather and particularly the rains during threshing very little of 8-A seed fit for the next sowings is available

in this circle. Indents for the next year's requirements are already pouring in and the situation had become very perplexing as enquiries in all directions brought negative replies until information was received to the effect that some Eastern districts had escaped the last disaster. Rupees 25,000 have been allotted for its purchase and with special arrangements an Agricultural Assistant has been deputed to obtain about 4-5 thousand maunds from Rohtak. But financial stringency and curtailment of travelling allowance allotments have created serious obstacles and it is not certain if complete requirements will be fulfilled.

The Farms.—Report on the Gurdaspur Agricultural Station has been separately submitted. The small demonstration farm at Beas has recently been taken over by the Government from Amritsar District Board and in addition 3 other District Board farms at Ludhiana, Jullundur and Sialkot and 2 private farms at Khalsa College, Amritsar and Borstal Jail, Lahore, respectively, have been maintained. Owing to lack of funds and staff the Kala Shah Kaku rice farm was given out on lease for 3 years with the proviso that the lessee will vacate should the Government demand the land. Ludhiana is still without an Agricultural Assistant and my functions there are only advisory but owing to the curtailment in travelling allowances I have not been able to visit it this year.

Jullundur District Board Farm.—Out of 50 acres the farm is divided as below :—

(*i*) Culturable—

	Acres.
Chahi	12
Barani	8
(*ii*) Reclaimable barani lands	20
(*iii*) Unreclaimable waste	5
(*iv*) Allotted to Schools for teaching	5

Therefore it is only 20 acres which form the actual working farm and which can give some return to the District Board, reclaimable sandy area only being a burden involving extra labour and expenditure. One acute trouble here as well as in all Jullundur District is the deficiency of water in the wells. There are 2 deserted and 2 working wells at the farm but both of the latter have practically no water for irrigation and become entirely dry if worked well for one hour. Cleaning and sinking iron " Kharoras " with an off chance of augmenting the water supply has failed and an expenditure of Rs. 478 rendered useless. The buildings at the farm are still inadequate as Manager's quarter, his office and seed godowns have not been added through for the former arrangements are in hand. Despite these drawbacks the farm has done exceedingly well and was fortunate in receiving most excellent testimonials from all visitors, high and low, the most dis-

tinguished being His Excellency the Governor and the Financial Commissioner (Development).

Besides demonstration of implements and growing the improved varieties of wheat and sugarcane this farm has conducted two experiments (*i*) Potato cultural experiment and (*ii*) Reclaimation experiment with various green manures. The details of the first experiment were described in the last report and were followed on the same lines. Briefly it consists of replacing hand labour by bullock power. The results are very encouraging indeed and decidely favour the "Bullock Power" both in respect of outturn of the crop and its money value per acre as shown below :—

Method.	Area in sq. yards.	Actual yield.		Yield per acre.		Actual expenditure.			Expenditure per acre.		
		Mds.	srs.	Mds.	srs.	Rs.	A.	P.	Rs.	A.	P.
Bullock power ...	1,919	80	37½	204	6	8	14	0	22	6	2
Hand labour ...	1,888	67	35	174	0	21	12	0	55	12	1

These results are very encouraging and since Juliundur and Sialkot (where the same experiment was also conducted) are great potatoe-growers the annual profit from the machine method is obvious.

In the reclamation of sands the fields are green manured with San every year and every alternate year. Last Kharif grew the second crop of San for manuring which made a greater growth this time than the previous crop. One field, however, has been divided into 4 equal parts to receive the following crops as green manures :—

(1) Indigo,

(2) Guara,

(3) San,

And the 4th plot receives Cactus Sarkanda Sheesham leaves and a certain amount of clay previously mixed and decayed in a heap at the time when green manures are ploughed in. This will illustrate the relative value of various green manures but great hopes are being concentrated in the last mentioned treatments. The results will be recorded next year.

The farm is the nucleus of the district propaganda in Jullundur and supplies seeds of new crops. Co 205 cane on second year's trial yielded 77·5 maunds of gur per acre and about 100 Rassas (sufficient for 100 kanals) of its sets were distributed in the district.

Income and Expenditure—

Income—

	Rs.	A.	P.
Sale proceeds	1,452	13	3
Outstandings (all recoverable) ...	167	5	0
70 maunds of wheat in store at Rs. 3-12-0 per maund ...	262	8	0
4 maunds 10 seers of Barley and Taramira at Rs. 3 per maund ...	12	12	0
Total ...	1,895	6	3

Expenditure—

	Rs.	A.	P.
Ordinary contingencies including expenditure for the reclamation of sandy land and pay of beldars ...	1,045	9	1
Price of iron, construction and sinking of the 1st Kharora ...	218	5	6
Construction of the Gur boiling house	48	11	3
Price of boiling pan	12	0	0
Charges for the second Kharora for well	260	0	0
Labour on cutting and collecting cactus for reclamation	8	0	0
Total, ...	1,592	9	10
	1,895	6	3
	1,592	9	10
Net profit ...	302	12	5

Sialkot District Board farm.—This is another well organised District Board farm. The land is uniformally good and is treated partly Barani and partly irrigated by one well and a second is being sunk by the District Board. The farm grows varieties of sugarcane, desi cottons and wheat for seed and demonstration purposes and has also conducted the potato cultural experiment as a duplicate of the work on Jullundur farm. This year's trials were not reliable owing to frequency of rains and late sowing of the crop but the last year's experiment gave a net profit of Rs. 80-8-0 per acre in Machine method against Rs. 19-15-0 from the local. The trial will now be discontinued at both Jullundur and Sialkot and will be conducted with two or three crops at Gurdaspur under my direct supervision in order to confirm the results prior to placing them before the public. Buildings are sufficient and in good condition.

Income and Expenditure.—Despite low prices of wheat and failure of potatoes and melons the farm has given a handsome net profit this year.

Income

		Rs.	A.	P.
Sale proceeds		2,551	5	6
81 maunds of wheat in store of Rs. 4-4 per maund...		344	4	0
Surplus Bhusa to be sold		200	0	0
Price of mangoes		60	0	0
Price of melons		60	0	0
Outstandings		400	0	0
Total ...		3,615	9	6

Expenditure—

Ordinary contingencies including pay of beldars	3,195	14	6
Net profit	419	11	0

Beas Farm.—This consists of about 43 acres of land conveniently situated along the Grand Trunk Road near the Beas Railway station. A small portion is irrigated from a well but the remainder is all Barani and covers a considerable area under deep pits and uneven land levelling of which has been a heavy strain on the working hands of the farm. Considerable progress in this has now been made and most of these pits have been levelled and laid out into long flat plots and for the first time in the history of the farm the whole area was put under a crop during the past rabi. There is only one well for irrigation but that too cannot supply sufficient water as it was originally constructed for drinking purposes only, therefore only about six acres can be commanded. There are still no buildings of any sort at the farm and staff and stock have had to be accommodated in an old ferry serai at a distance of one mile from the farm and there being no chowkidar the ravages of stray cattle and passers-by are often considerable. Under all these difficulties the farm has not yet shown any financial success and when it was just emerging from all past vicissitudes of its fortune it was victimized to the retrenchment axe and has been ruthlessly crippled. Only Rs. 1,300 have been alloted for the current year and there being still no buildings provided a sum of Rs. 15 per month as rent for the accommodation of the staff and stock has also to be met. It was thus impossible to continue the progress now almost completed and to remain within the small budget. The farm was therefore given to a tenant on 1st June 1923. Keeping only a small portion of about 12 acres under

the direct cultivatiou by the Department. The financial result this year are not very discouraging and show an income of Rs. 1,433-13-6 against an expenditure of Rs. 2,455-9-11 as compared with an income of Rs. 1,187-13-10 against an expenditure of Rs. 2,314-7-9 last year. The following gives their detail :—

Income—

	Rs.	A.	P.
Sale proceeds actually credited into Treasury excluding Rs. 565 price of wheat from Rabi 1921-22	670	4	9
Outstandings (all recoverable)	337	2	9
Estimated price of farm produce in the store	306	6	0
Inter-Departmental charges	120	0	0
Total ...	1,433	13	6

Expenditure—

Ordinary Contingencies (including pay of beldars)	1,946	9	5
Rent of the old serai from 1st April 1921 to 14th May 1923	509	0	6
Total ...	2,455	9	11
	1,433	13	6
Loss ...	1,021	12	5

PRIVATE INSTITUTIONS.

Khalsa College farm at Amritsar.—Although Government property it has been handed over to the Khalsa College for demonstration purposes. An Agricultural Assistant has been incharge and for management and advice it has been entrusted to the Agricultural Department whose functions there like Ludhiana are only advisory. The lay-out has been done in a way to provide actual handling of the various implements by the students of the College and to enable them to see the various type of field and vegetable crops. Two blocks are irrigated by the College tube-well and a third has been intentionally kept Barani. The well failed hopelessly this year at the most critical time, April to August 1922, and its repairs were so long that practically the whole of the Kharif 1922 failed. Nine acres under sugarcane, chillies, fodders and vegetables dried up altogether and had to be ploughed up but cotton. Desi varieties, survived and was the only returning crop of the season. The Barani area comprising long and deep brick kilns is being steadily cleared and levelled and so far about 6 plots have been uniformally laid out.

Income and Expenditure.—Inspite of the total failure of the Kharif the farm shows a profit according to figures supplied by Principal of the College given below :—

Income—

	Rs.	A.	P.
Sale proceeds	1,738	0	0
Estimated price of the various commodities in stores; feeding College animals, etc.,	2,358	11	0
Total ...	4,096	11	0

Expenditure—

	Rs.	A.	P.
Contingencies up to the end of May 1923 including pay of beldars, etc., ...	2,285	1	0
Estimated expenditure during June 1923 ...	112	0	0
1-3rd pay of the Agricultural Assistant (though an unfair charge) ...	850	0	0
Cost of water from the College tube-well ...	300	0	0
Total ...	3,547	1	0
	4,096	11	0
	3,547	1	0
Net profit ..	549	10	0

Borstal Jail Institution Farm.—Starting with brick-kilns and other deep pits a considerable portion of the site now been properly levelled and was brought under vegetables and wheat this year. Three old deserted wells are now in working conditions and a Mukaddam, a student from the Gurdaspur Vernacular Class, has been employed by the jail and is making good progress. The buildings are now badly needed for which sanction has apparently been requested by the Superintendent of the Jail.

Agricultural Associations.—An Agricultural Association in each district where actual work is in progress was maintained and meetings held. For Amritsar District where work has only recently been started an Association will form in the next year.

Demonstration of improved Gur boiling furnaces.—A study of the present mode of Gur boiling and improvements in the local furnaces was one of the most important problems undertaken in this section. Modifications of the McGlashan and improvements in the local furnace have been effected and detailed in a descriptive note submitted for publication. The McGlashan was constructed and demonstrated at various farms and in villages this year in order to pave its way for the spread in the next season. A brief leaflet for the benefit of the zemindars has also been written.

Publications.—A note on Co. 205 sugarcane has been published and a note on improved Gur boiling furnaces is in the press.

Staff.—The two Extra Assistant Directors of Agriculture performed their duties with zeal and continued enthusiasm. Mian Mukhtar Nabi in addition to his ordinary duties was deputed to study the progress in consolidation of land holdings in the Punjab and is engaged in drafting a leaflet with special reference to its bearings on Agriculture. He was also entrusted with the laborious task of studying the factors involved in fodder famine in the North Punjab and a comprehensive report with recommendations has already been submitted. Among the office hands M. Barkat Ali again deserves every credit and has managed to keep pace with the increasing burden of work. The accounts have been in the safe hands of Lāla Manohar Lall and I am very glad to record a whole-hearted co-operation and a real sense of duty shown by all the staff of my section.

MALIK SULTAN ALI,

Deputy Director of Agriculture, 1st Circle, Gurdaspur.

Statement showing record of progress made in concentration villages in the Gurdaspur Sub-circle.

District.	Village.	Progress made.
Sialkot ...	Fatehgarh ...	80 Meston Ploughs, 67 acres of 8-A and Pusa 12 wheats for the first year. Cotton and maize sown in lines and intercultured with Horse and Lyallpur hoes. Raja Plough, Spring tine and Bar Harrows given on loan are being used.
Do. ...	Kulla Mandial ...	25 Meston Ploughs already purchased and 25 recenty indented. A large area under 8-A and Pusa 12 wheats. Raja Plough, Lyallpur Hoe, Spring tine Harrow present, 15 acres of wheat were sown with Rabi drill — 3 kanals of new Co 205 cane.
Do. ...	Adamke Nagre ...	22 Meston Ploughs, 40 acres of 8-A, 5 kanals of Co 205. Raja plough — Rabi and Kharif drills and Bar Harrow on loan. Cotton sown in lines.
Do. ...	Jandu Sahai ...	15 Meston Ploughs purchased and 25 indented. 25 acres of 8-A and Pusa 12. Plague prevented further progress.
Do. ...	Azizpur in Dugre Hinduan.	Here one cultivator has entirely discarded the Desi *hal* and is working solely on new lines. He has got 4 Raja and 7 Meston Ploughs, 2 Bar Harrows — a Spring tined and a Lever Harrow — a Hand hoe and 2 Chaff cutters. Maize and cotton sown in lines and intercultured. Nothing but 8-A and Pusa 12 wheats.
Amritsar ...	...	The work here has only recently been started by the Agricultural Assistant posted at Beas in addition to his farm there. 30 Mds. of 4-F American *Kapas* seed was sent for from Sargodha and as a start 131 acres have been put under this crop in Taran Taran Tahsil.
Jullundur ...	Chima Kalan ...	The entire village grews 8-A and Pusa 12 wheats. Cotton sown in lines and intercultured. New McGlashan furnace introduced. 4 Chaff cutters, 4 Raja and 3 Meston Ploughs.
Do. ...	Jhugian ...	6 Meston Ploughs — 8-A and Co 205 cane introduced.
Do. ...	Gharhi Bharti ...	12 Meston Ploughs, 1 Raja Plough, Co 205. introduced, wheats mostly Pusa 12 and 8-A.
Do. ...	Kandolla ...	14 Mestons 8 Rajas, 3 Imitation hoes and harrows and 2 Chaff Cutters. 8-A wheat and Mollisoni Cotton introduced. Meston shares and the Imitation hoes and Harrows are made by the Local smiths.

Statement showing record of progress made in concentration villages in the Gurdaspur Sub-circle—concluded.

District.	Villages.	Progress made.
Jullundur ...	Beas Pind ...	Pusa 12 wheat — 3 Mestons sold and 5 more indented, 2 Rajas.
Hoshiarpur ...	Daulowal ...	6 Mestons, 50 acres of Pusa 12. 15 acres of 8-A, 3 kanals of Co 205 cane, 2½ acres of Mollisoni Cotton.
Hoshiarpur ...	Bhakowal ...	15 Meston Ploughs, 1 Chaff Cutter, 8-A and Mellisoni Cotton introduced.
Do. ...	Babowal ...	10 Mestons, 140 acres of 8-A.
Do. ...	Jehan Khelan ...	500 acres of 8-A and Pusa 12, 3 acres groundnuts, 2 Mestons, 1 Raja, 1 Horse Hoe, 1 Chaff Cutter, 1 winnower, Japan Sarson 2 acres and Co 205 1 acre.
Gurdaspur ...	Bhanimilwan ...	Entire village converted, every one possesses a Meston, only improved wheats and canes are grown. The Co operative Union stocks and sells Meston ploughs and shares. Other implements are 1 Raja, 3 Chain Harrows, 1 Bar Harrow, 1 Jat Plough and 1 Spring tined Harrow.
...	Pakhowal ...	This is another greatly converted village and has 16 acres of 8-A, 2 acres of Pusa 12,1 acre of Pusa 4, 50 Meston Ploughs, 3 kanals of Co 205 Cane and 1 of Co 223 cane.
Do. ...	Bayanpore ...	27 Mestons, Co. 205 introduced.
Do. ...	Khojepur ...	10 Mestons, 6 acres of 8-A and 40 acres Pusa 12.
Do. ...	Jamalpur ...	5 Meston Ploughs, 1 Bar Harrow and a loan of some implements, 40 acres Pusa 12, 60 acres 8-A.
Do. ...	Sujowal ...	1 Raja, 4 Mestons, 10 acres 8-A, 1 acre Pusa 20 acres Pusa 12, some implements on loan.
Do. ...	Mumrai ...	5 Mestons, 30 acres 8-A, 15 acres Pusa 12-A Raja Plough and a Bar Harro on loan.

No. 1.—*Statement showing the rainfall at several important centres in the Sargodha Sub-circle.*

Name of month.	Sargodha.	Shahpur.	Bhalwal.	Chilli-anwala.	Gujrat.	Khabian.	Phalia.
	Rainfall in inches.	Rainfall in inches.	Rainfall in inches.	Rainfall in inches.	Rainfall in inches.	Rainfall in inches.	Rainfall in inches.
July 1922 ...	1·29	2·82	3·29	4·68	4·10	6·20	4·43
August 1922 ...	5·39	5·2	3·95	3·46	4·08	4·82	3·20
September 1922 ...	0·26	0·53	2·22	4·54	6·87	4·45	8·28
October 1922 ...	0·23	0·44	0·58	0·27	0·07	0·15	0·30
November 1922 ...	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
December 1922 ...	0·89	0·84	1·57	2·03	2·44	1·83	1·30
January 1923 ...	0·82	0·76	0·25	0·93	2·17	1·54	0·77
February 1923 ...	3·61	3·1	3·37	2·75	3·42	4·17	2·17
March 1923 ...	0·68	0·49	0·85	0·42	0·88	0·97	0·55
April 1923 ...	0·87	0·27	0·50	0·37	0·55	0·65	0·34
May 1923 ...	2·87	4·28	4·84	4·52	2·11	2·54	1·87
June 1923 ...	0·12	0·33	1·96	...	0·21	0·39	...
Total ...	17·03	19·06	22·88	23·97	26·40	27·71	23·21
Average ...	14·65	13·90	Not fixed	Not fixed	26·35	28·34	19·49

No. 2.—*Statement showing the results of American Cotton Auction sales during the year 1922-23.*

Name of place.	Class A-1.		A-2.		B.		C.		Remarks.
	Weight.	Rate.	Weight.	Rate.	Weight.	Rate.	Weight.	Rate.	
	Mds.	Rs. A. P.	Mds.	Rs. A. P.	Mds.	Rs. A. P.	Mds.	Rs. A. P.	
Sargodha	1,436	19 14 0	533	19 12 6	1,689	19 11 6	300	19 4 0	285-F., American cotton 215 maunds at Rs. 19-15-0 per maund.
Phullarwan	...	...	210	20 8 0	917	20 4 6	426	20 2 0	
Baha-ud-Din	2,015	Not auctioned	...	...	1,317	Not auctioned	141	17 4 0	There was no A, and A$_2$ at Baha-ud-Din. The whole was classed as A.

No. 3.—*Statement showing the results of Demonstration Plots in the Central Districts (Gurdaspur Sub-circle).*

Serial No.	Name of District.	Name of village.	Kind of Crop.	Kind of Experiment.	Yield per acre. Mds.	Srs.	Chs.	Remarks.
1	Gurdaspur	Pakhowal	8-A... Wheat	Varietal	7	0	0	In all varietal tests in this district 8-A has yielded more than the Local.
			Local ,,	,,	5	0	0	
2		Laloo Chak	8-A ... Wheat	,,	6	3	0	
			Local ,,	,,	3	32	0	
3		Khojipur ...	8-A... Wheat	,,	11	34	0	
			Local ,,	,,	11	1	0	
4		Jagowal ...	8-A... Wheat	,,	4	14	0	
			Local ,,	,,	3	34	0	
5		Talwandi ...	8-A... Wheat	,,	16	21	0	
			Local ,,	,,	13	31	0	
6		Darapur ...	8-A... Wheat	,,	7	9	0	
			Local ,,	,,	6	17	0	
7		Rajpur Rajputan.	8-A... Wheat	,,	13	37	0	
			Local ,,	,,	9	26	0	
8		Pindi Umra	8-A... Wheat	,,	10	25	0	
			Local ,,	,,	9	26	0	
9		Bhatian ...	8-A... Wheat	,,	9	26	0	
			Local ,,	,,	7	29	0	
10		Niamatpur	8-A... Wheat	,,	11	23	0	
			Local ,,	,,	9	26	0	
11		Sojowal ...	8-A... Wheat	,,	9	14	0	
			Local ,,	,,	6	2	0	
12		Boora Dalla	8-A... Wheat	,,	4	11	0	
			Local ,,	,,	9	26	0	
13		Mumrai ...	8-A .. Wheat	,,	11	11	0	
			Local ,,	,,	9	29	0	
14		Mari Buchian	8-A Wheat	,,	11	24	0	
			Local ,,	,,	10	36	0	
15		Withwan ...	8-A... Wheat	,,	16	7	0	
			Local ,,	,,	16	1	0	
16		Berampore ..	Wheat ...	*Cultural* Raja ...	4	14	0	With the exception of plot Nos. 16 and 19 where outturn is more in case of Desi Plough, the results of all other plots tilled with Raja Plough show superiorty of the Raja over the Desi Plough.
				Desi ...	5	23	0	
17		Mamoon ...	,, ...	Raja ...	16	3	0	
				Desi ...	13	31	8	
18		Sarjal ...	,, ...	Raja ...	12	2	0	
				Desi ...	10	22	0	
19		Fattowal ...	,, ...	Raja ...	13	31	0	
				Desi ...	14	32	0	
20		Sojowal ...	,, ...	Raja ...	15	17	0	
				Desi ...	11	23	0	
21		Mumrai ...	,, ...	Raja ...	10	7	0	
				Desi ...	9	13	0	
22		Withwan ...	,, ...	Raja ...	24	5	0	
				Desi ...	21	28	0	
23		Bullowal ...	,, ...	Raja ...	15	17	0	
				Desi ...	11	23	0	

No. 3.—*Statement showing the results of Demonstration Plots in the Central Districts (Gurdaspur Sub-circle)*—continued.

Serial No.	Name of District.	Name of village.	Kind of Crop.	Kind of Experiment.	Yield per acre. Mds.	Srs.	Chs.	Remarks.
				Cultural				
24	Gurdaspur—*concld.*	Chicherawal	Wheat ...	Raja ...	10	23	0	
				Desi ...	9	26	0	
25		Khojala ...	,, ...	Raja ...	12	12	0	
				Desi ...	11	10	0	
26		Khokharwal	,, ...	Raja ...	9	0	0	
				Desi ...	7	38	0	
27		Pinda Ruri	,, ...	Raja ...	9	0	0	
				Desi ...	7	38	0	
28		Withwan ...	,, ...	Raja ...	10	30	0	
				Desi ...	10	18	0	
1		Kolian ...	,, 8-A	Varietal ..	13	5	0	8-A better than Pusa-12.
			,, Pusa-12		11	33	8	
2		Bhikhowal	,, 8-A	,, ...	10	20	0	8-A better than Local.
			,, Local		7	30	0	
3		,, ...	Sugarcane Co. 205	,, ...	67	20	0	Co 205 Cane better than the Local.
			Sugarcane Local		50	16	0	
4		Chotala ...	Sugarcane Co. 205	,, ...	63	0	0	Both equal here.
			Sugarcane Local		63	0	0	
				Cultural				
5		Bohan ...	Wheat Local	Raja ...	16	32	0	
				Desi ...	16	32	0	
6		Boothgarh...	,,	Raja ...	13	5	0	Results generally in favour of the Raja Plough.
				Desi ...	10	20	0	
7		Jehan Khelan	,,	Raja ...	9	26	0	
				Desi ...	13	24	0	
8		Kala Jhingar	,,	Raja ...	19	10	0	
				Desi ...	15	30	0	
9	Hoshiarpur ...	Darapur ...	,,	Raja ...	12	24	0	
				Desi ...	10	20	0	
10		Pindori Malian.	,,	Raja ...	12	24	0	
				Desi ...	10	20	0	
11		Dhido Katrala.	,,	Raja ...	10	10	8	
				Desi ...	8	16	0	
12		Bhikhowal...	,,	Raja ...	13	5	0	
				Desi ...	11	32	8	
13		Kaindwal ...	,,	Raja ...	6	29	0	
				Desi ...	5	35	0	
14		Bahowal ...	,,	Raja ...	6	12	0	
				Desi ...	6	12	0	
15		Kaindwal ...	,,	Raja ...	6	12	0	
				Desi ...	6	12	0	
16		Boothgarh...	Sugarcane	Co. 205 ...	77	8	0	Co 205 Cane better than the Local variety.
				Local ...	50	16	0	
17		Kala Jhingar	,,	Co. 205 ...	47	10	0	
				Local ...	42	0	0	
18		Bhikhowal...	,,	Co. 205 ...	63	0	0	
				Local ...	57	30	0	

No. 3.—*Statement showing the results of Demonstration Plots in the Central Districts (Gurdaspur Sub-circle)*—continued.

Serial No.	Name of District.	Name of village.	Kind of Crop.	Kind of Experiment.	Yield per acre. Mds. Srs. Chs.	Remarks.
				Cultural		
1	Jullundur	Chima Kalan	8-A Wheat...	Raja ...	15 30 0	With the exception of plot No. 1 results in favour of the Raja Plough.
				Desi ..	13 35 0	
2		Budala Mansurpur.	,, ...	Raja ...	14 27 8	
				Desi ...	14 15 0	
3		Khatkar Kalan.	,, ...	Raja ...	16 16 4	
				Desi ...	12 32 8	
4		Chak Bilga	Wheat, Local	Raja ...	14 20 0	
				Desi ...	13 5 0	
5		Garhi Bharti	Wheat. Desi	Raja ..	13 0 0	
				Desi ...	12 27 8	
6		Beas Pind...	Wheat, Desi Kathi.	Raja ..	10 16 0	
				Desi ...	10 0 0	
7		Jhugian ...	Pusa-12 ...	Raja ...	18 10 0	
				Desi ...	17 37 8	
8		Bhundian ...	Crop failed on account of excessive flood water standing in the crop for a number of days.			
				Varietal		
9		Chima Kalan	Wheat Pusa-12 / 8-A	...	15 0 0	Pusa-12 better than 8-A.
					13 13 0	
10		Jhugian ...	,, Local Red 8-A	,, ...	16 35 0	8-A better than Local.
					13 30 0	
11		Alawalpur...	,, Local White 8-A	,, ...	7 20 0	
					8 5 0	
12		Goraya ...	,, Desi 8-A	,, ...	No record could be had on account of the wheat bundles mixed with each other by wind storm and rain.	
				Cultural		
1	Sialkot	Mitakpur ...	Wheat ...	Raja ...	16 33 0	Results generally in favour of furrow turning Ploughs.
				Desi ...	15 39 0	
2		Pasrur ...	,, ...	Raja ...	19 0 0	
				Desi ...	18 20 0	
3		,, ...	,, ...	Raja ...	15 0 0	
				Desi ...	15 20 0	
4		,, ...	,, ...	Raja ...	17 0 0	
				Desi ...	16 36 0	
5		Kulla Mandiala.	,, ...	Raja ...	15 4 0	
				Desi ...	15 8 0	
6		,,	,, ...	Raja ...	16 26 0	
				Desi ...	16 5 0	
7		,,	,, ...	Raja ...	15 30 0	
				Desi ...	14 29 0	
8		,,	,, ...	Raja ...	16 20 0	
				Desi ...	15 33 0	
9		,,	,, ...	Raja ...	4 8 0	Poor soil.
				Desi ...	4 10 0	

No. 3.—*Statement showing the results of Demonstration Plots in the Central District (Gurdaspur Sub-circle)*—continued.

Serial No.	Name of District.	Name of village.	Kind of Crop.	Kind of Experiment.	Yield per acre. Mds. Srs. Ch.	Remarks.
				Cultural.		
10	Sialkot—*concluded.*	Kulia Mandiala.	Wheat ...	Raja ...	15 36 0	
				Desi ...	15 20 0	
11		Charwa ...	,, ...	Raja ...	10 0 0	
				Desi ...	8 0 0	
12		Nangal Ram Chand.	,, ...	Raja ...	19 0 0	
				Desi ...	16 15 0	
13		Badiana ...	,, ...	Raja ...	11 0 0	
				Desi ...	10 20 0	
14		,, ...	,, ...	Raja ...	15 33 0	
				Desi ...	15 9 0	
15		,, ...	,, ...	Raja ...	9 0 0	
				Desi ...	8 4 0	
16		Dallum ...	,, ...	Raja ...	13 10 0	
				Desi ...	13 10 0	
17		Fatehgarh...	,, ...	Raja ...	17 0 0	
				Desi ...	16 0 0	
18		,, ...	,, ...	Raja ...	13 13 0	
				Desi ...	12 20 0	
19		,, ...	,, ...	Raja ...	13 8 0	
				Desi ...	12 32 0	
20		,, ...	,, ...	Meston ...	17 0 0	
				Desi ...	16 20 0	
21		,, ...	,, ...	Meston ...	16 0 0	
				Desi ...	16 0 0	
22		,, ...	,, ...	Meston ...	14 16 0	
				Desi ...	14 0 0	
23		Adam-ki-Nagri.	,, ...	Raja ...	14 18 0	
				Desi ...	14 0 0	
24		,,	,, ...	Raja ...	10 32 0	
				Desi ...	10 20 0	
25		,,	,, ...	Raja ...	12 30 0	
				Desi ...	12 20 0	
26		,,	,, ...	Raja ...	16 20 0	
				Desi ...	16 6 0	
27		,,	,, ...	Raja ...	13 13 0	
				Desi ...	12 33 0	
28		,,	,, ...	Meston ...	13 0 0	
				Desi ...	12 30 0	
29		,,	,, ...	Meston ...	15 13 0	
				Desi ...	15 11 0	
30		Kul Bajwa	,, ...	Raja ...	10 26 0	
				Desi ...	10 13 0	
31		Dugre Hinduan.	,, ...	Raja ...	17 10 0	
				Desi ...	17 9 0	
32		,,	,, ...	Raja ...	11 7 0	
				Desi ...	10 36 0	

No. 3.—*Statement, showing the results of Demonstration Plots in the Central Districts (Gurdaspur Sub-circle)*—continued.

Serial No.	Name of District.	Name of village.	Kind of Crop.	Kind of Experiment.	Yield per acre. Mds. Srs. Ch.	Remarks.
				Cultural		
33	Sialkot—*continued.*	Dugre Hinduan.	Wheat ...	Raja ...	12 12 0	
				Desi ...	12 0 0	
34		,,	,, ...	Raja ...	12 0 0	
				Desi ...	11 28 0	
35		Khakh ...	,, ...	Raja ...	16 19 0	
				Desi ...	16 19 0	
36		Kullah Mundiala.	8-A ...	Varietal	16 16 0	
			Local Wheat		15 32 0	
37		,,	8-A ...	,,	16 36 0	8-A better than the Local.
			Local Wheat		15 24 0	
38		,,	8-A ...	,,	19 0 0	
			Local Wheat		19 20 0	
39		Naurang Chana.	8-A ...	,,	17 0 0	8-A first; Pusa-12 2nd and Local 3rd.
			Pusa-12 ...		16 30 0	
			Local ...		16 4 0	
40		Narowal ...	8-A ...	,,	14 26 0	8-A better than Wadanak (Durum).
			Wadanak ...		14 20 0	
41		,,	8-A ...	,,	9 13 0	8-A better than Local.
			Local Wheat		9 4 0	
42		,,	8-A ...	,,	18 25 0	Ditto.
			Local Wheat		18 0 0	
43		,,	8-A ...	,,	16 18 0	Ditto
			Local Wheat		16 0 0	
44		Chandowal	Pusa-12 ...	,,	13 36 0	Pusa-12 better than Local.
			Local ...		13 33 0	
45		,,	8-A ...	,,	15 0 0	8-A better than Local.
			Local ...		14 13 0	
46		Adam-ke-Nagri.	8-A ...	,,	17 8 0	Ditto.
			Local ...		16 14 0	
47		,,	8-A ...	,,	17 20 0	Ditto.
			Local ...		17 16 0	
48		,,	Pusa-12 ...	,,	18 27 0	Pusa 12 better than Local.
			Local ...		17 20 0	
49		,,	8-A ...	,,	18 5 0	Pusa-12 1st; 8-A 2nd and Local last.
			Pusa-12 ...		18 25 0	
			Local ...		17 0 0	
50		Fatehgarh	8-A ...	,,	17 0 0	8-A better.
			Local ...		16 20 0	
51		,,	8-A ...	,,	13 13 0	
			Local ...		12 0 0	
52		,,	Pusa-12 ..	,,	17 8 0	Pusa-12 better.
			Local ...		15 26 0	
53		Jhandu Sahi.	8-A ...	Varietal	18 14 0	8-A, Pusa and Local in order of merit.
			Local ...		17 35 0	

No. 3.—*Statement showing the results of demonstration plots in the Central Districts (Gurdaspur Sub-circle)*—concluded.

Serial No.	Name of District.	Name of village.	Kind of Crop.	Kind of Experiment.	Yield per acre. Mds.	Srs.	Ch.	Remarks.
54	Sialkot—*concluded.*	Jhandu Sahi.	Pusa-12 ...	,,	20	0	0	Pusa-12 better.
			Local ...		18	21	0	
55		Dallun ...	8-A ...	,,	12	33	0	8-A better.
			Local ...		12	10	0	
56		,,	Pusa-12 ...	,,	17	25	0	Pusa 12 better.
			Local ...		17	8	0	
57		Budha Goraya.	8-A ...	,,	18	3	0	8-A better.
			Local ...		16	35	0	
58		,,	8 A ...	,,	17	20	0	Pusa-12, Local and 8-A in order of merit.
			Local ...		17	24	0	
			Pusa 12 ...		18	20	0	
59		Badiana ...	8-A ...	,,	18	0	0	8-A better.
			Local ...		15	33	0	
60		Dugre Hindaan	8-A ...	,,	17	32	0	Ditto.
			Local ...		16	25	0	
61		Nangal Ram Chand.	8-A ...	,,	17	32	0	Ditto.
			Local ...		16	36	0	

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY

No. 4.—*Statement showing sale in the* 1st *Circle, Gurdaspur, of Improved Agricultural Implements during the year ending June 30th,* 1923.

Imported Implements.		Implements manufactured by the Punjab Agricultural Department.		Implements manufactured in India.	
Name of implements.	No. sold.	Name of implements.	No. sold.	Name of implements.	No. sold.
Raja ploughs	38	Bar Harrows	36		
Meston ploughs (English) ...	275	Drills	2	Imitation Meston ploughs made in Punjab and elsewhere in India.	156
Other ploughs, Punjab and Chatta Nooga.	2 and 13	Lyallpur Hoes	...		
Raja Reapers	...	...	...		
Hoes	1	...	...	Shares for both ...	1,000
Harrows	9	...	...	Nahan Sugarcane Crushing Mills	...
Simplex Fodder Cutters	13	...	...	Crushing Mills (others) ...	28
Raja „ „	7	...	...	...	...
Imported shares for imported ploughs (all sorts).	100	...	...	...	...
Miscellaneous (Hossier Drill) ...	1	...	...	...	...

XC

No. 5.—*The following implements were sold directly by various firms during the year ending 30th June* 1923 *in addition to those already given in the Report.*

(1)	Rajah ploughs	35
(2)	Spring-tined Harrows	12
(3)	Rajah Fodder cutters	4
(4)	Planet junior single wheel Hand Hoe...	1
(5)	Meston plough shares	50

APPENDIX VIII.

Annual Report by Sardar Darshan Singh of Vahali, I.A.S., Deputy Director of Agriculture, Punjab, Hansi, for the year ending 30th June, 1923.

Introductory.—The charge of this circle, which forms south-east of the province, and comprises of all the *cis*-Sutlej districts (except Ludhiana and Hoshiarpur) and includes Delhi Province was held by me during the year under report, except for a period of about 10 weeks, from 1st July to 5th September, when Khan Sahib Maulvi Fateh-ud-Din, I. A. S., held the charge during my absence on leave out of India.

Active propaganda and demonstration work has steadily increased, and is going on, in nearly all the districts. The agricultural improvement effected since 1914, when this circle was formed, and the Hansi Agricultural Station opened, is indeed worth special consideration, in face of the many difficulties that the peculiar backward conditions of this circle presented ; greatly added by the unfavourable and inopportune period of the development, owing to the great war that started about the same time and consequent heavy prices of imported implements, absence of quite a large number of youthful energetic agriculturists from their homes, the financial stringency, and the greatest of all paucity of staff to cope with the ever-increasing work, in the development of the departmental activities and the immense call for assistance from the zamindars and cultivators. It was under such conditions and limitations the progress has been achieved.

Season.—The season on the whole has been favourable, and was a great improvement on the last year's, but owing to the dry spell for about a month in August 1922 the Kharif crops in some of the districts greatly suffered, and it was only with the subsequent rains that they revived and sprouted again. The rains in September, however, again did considerable damage to the Kharif in parts of Ambala and Karnal Districts, Sonepat Sub-Division and Gurgaon District. The cottons which were in flowers and were forming bolls suffered badly. The hailstorm of 16th October 1922 is reported to have done great damage to all the standing Kharif.

The sowings of Rabi were extensive owing to the rains at proper time. The cloudiness of the weather during January and February encouraged rust which appeared nearly in all the districts, but the February rains washed it down, and the damage was reduced to some extent. The dry western winds in March interfered with the proper and healthy development of the wheat grain. The wheat was consequently shrivelled and the yield reduced. The thrashing of Rabi crops, especially the wheat, was unusually delayed owing to the rains in the month of May, and unfavourable winds for winnowing.

The main branches of district demonstration and propaganda work are mainly the same as last year, and may be summarized under the following heads :—

(1) Growing of the improved varieties of crops under the departmental supervision for seed purposes. Collection, storage and distribution of such seeds to the cultivator.

(2) Arrangements for the disposal of the produce of improved crop at rates higher than those ordinarily obtainable in the local markets by auctions, collective sales or private arrangements; as an encouragement to the growers of the improved varieties.

(3) Demonstration of improved methods of cultivation and raising of crops.

(4) Demonstration of Improved Agricultural Implements and instructions to the cultivators in handling and using the same.

(5) Arrangements for supplying Improved Agricultural Implements.

(6) Agricultural Associations.

(7) Demonstration farms, demonstration plots and seed farms.

(8) Supplying general information to the cultivator and giving him advice in Agricultural matters.

Crops and Seeds.—We have now arrived at a stage when we are able to place in the hands of cultivators seeds of decided and undoubted superiority of four of the most important crops of the circle, *i.e.*, cotton, wheat, sugarcane and barley.

The selection of the Desi cotton has gained popularity and reputation and 8-A wheat is now admitted favourite of its growers. The Co. 205 sugarcane is an alround suitable cane giving high yields and commended by the zamindars for its hardiness.

The barley type No. 4 has given good yields and is in great demand in the barley growing tracts of Gurgaon where its superiority over the local type is fully established.

Various other seeds, too, like Australian Bajra, Jowar, lucerne, oats, Japan rape, groundnut, rice, seeds of grasses (*e.g.*, Anjan) are supplied, but only in small quantities, whenever required by the zamindars, as so far these have not been seriously handled anywhere in the Punjab. Systematic work has, however, been started with Bajra and Jowar at Hansi Agricultural Station.

Cotton.—American cottons are not suitable for the greater part of the circle, and there is not a very hopeful field for them, owing to the reasons mentioned in my Annual Report of 1921. Ferozepore is the only district in this circle which offers scope for American cotton.

This crop was badly hit there in the year 1920, its cultivation was greatly reduced and the area under this during Kharif 1922 was only 700 acres. This year the area increased to 1,200 acres, and it is hoped that this cotton will regain its position in a few years' time. Both 4-F and 285-F were grown. The yield of both these varieties is reported to be very much the same, *i.e.*, from 12 to 15 mds., 285-F, however, getting a premium of Re. 1 over the 4-F.

Desi cottons—White Flowered Neglectum Bhatla Selected has gained wide popularity and enjoys the confidence of its growers. This cotton has had exhaustive trials at numerous places in this circle as well as outside it, both with private growers and at demonstration farms of this circle, and has given very good yields. Reports have, however, been received from the eastern districts, with heavier rainfall, that the heavy rain in September did more damage to this variety. I attach the statement showing the results of its yield at the Beas Demonstration Farm, Khalsa College Farm, Amritsar, and Sargodha Seed Farm, and it is encouraging to notice that it has topped everywhere. Reports from private growers of the Canal Colonies are also favourable.

The area under this selection during 1922 has been reported to be 22,476 acres (this is the actual area recorded by the Agricultural Assistants though as the variety is widespread and the zamindars kept their own seed, there is great possibility of quite a large area having not been included in this estimate. This view is strengthened from the fact that good many carts were brought to the market said to have been grown from the farm seed of which our Agricultural Assistant on district work was unaware). Indeed it is impossible for one Agricultural Assistant in the district to be in touch with all the growers of so extensive an area.

A moderate estimate of net increase in profits per acre in different districts ranges between Rs. 36 and 49, and therefore the total profit during the year may be estimated between 8 and 9 lacs of rupees.

With a view to help the growers auctions were organised, and at the first auction a premium of Rs. 2-6-0 per maund was obtained for the A class. The prices would have been higher, but our probable buyers—Messrs. Volkart Brothers—were unable to rent a factory in Hansi and other outside buyers were unable to compete owing to railing difficulties. At the following auction the local buyers united and only a premium of Rs 1-9-0 per maund was obtained. Therefore collective sales were organised and tenders invited, to avoid the trouble of the auction and the difficulties of bringing large quantities of Kappas to the market on a fixed day. As a result a premium of Rs. 1-8-0 per maund was obtained and village deliveries were arranged. The quantity sold in this manner through the Department was 60,000 maunds, and the zamindars were satisfied with the premium that was distributed to them through our agency. Buyers were also satisfied as owing to its good quality they made a handsome profit from the bargain inspite of the premium they paid.

The area under this Kappas this year is reported to be 32,405 acres (though probably there is large area which the Agricultural Assistants have not been able to record as above explained). The area would have been much larger, but for the difficulties of seed arrangements. With the limited staff at my disposal for roguing operations in the fields, collecting, marketing and supervising the ginning, in the factories of the buyers, it was not an easy task to obtain large quantities of seed. I may here add that it is much more difficult to distinguish the seeds of the Desi varieties and to detect their mixture, than is the case with the Desi mixture in the American seed. We

were therefore only able, with difficulty, to secure about 3,009 maunds. The ginning factory has not yet been put up, although its urgent necessity has been felt for some years now. This was foreseen by me, and the question of putting up the ginning factory was moved in the year 1919. But for this defect this cotton would have been the predominating type in the district by now.

Demands for seed of a large number of growers of this circle, as well as outside orders could not be met.

Efforts have esuccessfully been made to grow this seed in the neighbourhood of our farm at Hansi to ensure a good supply of pure seed to outsiders, but the arrangements for securing this seed will remain as defective as before, and we will not be able to guarantee the purity of our seed, as long as our ginning plant is not put up. Indeed I am anticipating that the two gins originally proposed will not be sufficient, unless the zamindars begin to keep their own seed.

We have no excuse why the Department should not put into the hands of a grower better seed when he is anxious to grow it, and money ought to be found for this work from somewhere.

As mentioned in the report of Hansi Agricultural Station, further selections are being made, and there is every hope that a still better variety, with a higher ginning percentage will be forthcoming in the years to come.

Wheats.—Type 8-A. has for several years given very good yield in this circle and is now very extensively grown in all the districts except in Ambala Khadar where Punjab-11 is still preferred. 8-A is a heavier yielder, bearded and is therefore less liable to damage by birds, has nice looking, amber coloured grain and is an alround good variety. Its yields in the district on zamindari land are reported to be up to 40 maunds per acre.

Eleven thousand and three hundred maunds seed of this variety was secured last year for distribution, besides 5,000 maunds were purchased from the Rohtak District for the Gurgaon District Board for distribution there. Besides a very large quantity of seed was kept by its growers and private people. The area under this variety during the Rabi 1922-23 was 54,035 acres. It is now widely spread, and is already recognised as a separate class in some of the Mandies of this circle where it fetches two to three annas premium per maund over the best local. Very large quantities of its seed are already in the hands of zamindars and growers. However, about 8,000 maunds of its seed is being stored for distribution in places where it has already not been grown.

Pusa-12 is still the favourite on well-irrigated lands, especially in the neighbourhood of Panipat, where it has given very heavy yields, and is extensively grown. On the well lands of the Ferozepore District its area is reported to be 6,000 acres.

The area under Punjab-11 was little over 2,000 acres. Mr. Milne's new type 16-A is also under trial.

The total area under our improved types of wheat during the last Rabi was 62,446 acres.

Sugarcane.—Co. 205 has done well at the Hansi Agricultural Station during the past two seasons. It was last year given out for trial in Hissar, Rohtak, Karnal and Ambala districts, and the reports of stand and yield were very satisfactory. I give below some of the results :—

Name of District.	*Outturn per acre.*		
	Maunds	Seers	Chataks.
Karnal	68	28	2
,, ...	67	32	9
Hissar	66	0	0
Ambala	crop was spoiled by animals. It looked better than local, and was very much liked by the people.		

Its seed has this year been distributed in Karnal, Rohtak, Ambala, Ferozepore, Hissar, Gurgaon districts and Delhi Province.

In the Ferozepore District where thick cane for chewing purpose is mainly grown striped Mauritius is reported to have done well and is being grown at Ferozepore, Karyan and Mahmud Khera villages.

Barley.—Type No. 4 after several years' trial, at the Hansi Farm, had two years ago been given out in the Gurgaon District. Its superiority over the local is established and its seed is in great demand by the growers. I am this year sending the total barley produce (200 maunds) at Hansi Agricultural Station to the Gurgaon District for distribution.

Bajra and Jowar.—Work on these two important crops of this circle has been systematically taken up at Hansi Agricultural Station, but it is regretted that it is being greatly hampered for want of staff.

Australian Bajra was tried in Gurgaon last year and gave good yield. This year at the request of growers seed of this variety has been supplied for distribution.

Rice.—Seed of Bara rice was obtained from the Agricultural Officer, North-West Frontier Province, and is now under trial at Chandigarh and Hansi Agricultural Station. Two varieties received from Cattack were tried in Ambala District, but these have given poor yields. The crop at Jallalabad in Ferozepore District failed on account of appearance of rice bug.

Other crops.—Seeds of Japan rape, oats, lucerne, Shaftal groundnut, Anjan, etc., were supplied to the zamindars and trials made in various districts of the circle.

Seed depôts.—In our seed depôts we mainly supply the seed of important crops and agencies are opened at several places in each district. This year we are also helping the Gurdaspur circle in the purchase of pure and good seed of 8-A from the Rohtak District.

Sowing of cottons in lines.—This was demonstrated in many villages of this circle, and 600 and 160 acres in the districts of Hissar and Rohtak, respectively were sown in lines. In Ferozepore, District cotton was sown in lines at Azimgarh, Baring Bhera, Kania, Zira Langiana and Ghail Kalan. It is chiefly a labour problem, and as long as labour for hoeing is available the scope for its extension will remain limited as the Horse Hoe is an expensive hoeing implement. Hoeing is usually done with the Country Kasola at a time when labour is available.

Sowing of Maize in lines.—Nine bighas of maize were sown in lines at Bihta (Ambala District) side by side to broad-casted maize. The outturn from this plot was 40% more besides the saving in labour. This was appreciated, and it is expected that larger area will be sown in lines during the present kharif.

Green Manuring.—Demonstrations to show the advantages of green manuring have been going on in the Ferozepore District for some years. San (hemp) and Gawara were used as green manures. Like last year, trials were made at Baga Purana, Dungar Khera, Puhla, Chak Mahan Badar, Baring Khera and Pato Hira Singh. Two plots of each kind were harvested. In case of plots manured with San there was an increase of yield from 3½ to 7 maunds. For detailed results please see end of report.

Eradication of grasses.—Demonstrations of eradication of Dab and other injurious grasses were given in many places in this circle, and results of some of the demonstration plots are given at the end of this report.

Seed rate.—In some parts of the circle absurdly high seed rates for wheat, *i.e.*, between 40 and 60 seers are used, which is a great waste. Demonstration to show that 25 seers for well prepared seed bed is quite enough, while it need not be more than 35 seers in any case, were given.

Gur preparing.—Sugarcane is an important crop in the Karnal District, but the method of preparing Gur is very primitive, and Gur made is usually of inferior quality.

Demonstrations in Gur making were given. Next year the demonstration for the improved furnace will be arranged.

Siloes.—Siloes of Jowar, neem and shisham leaves were prepared by the Agricultural Assistant at the suggestion and with the help of Deputy Commissioner at Gurgaon, and were opened and fed to the bullocks in the presence of the members of the District Board. The chari and the neem fodder was eaten by the bullocks with relish.

Demonstration and Sale of Improved Implements.—A vigorous campaign and active propaganda have been going on throughout the year to demonstrate the improved implements, and over 200 such demonstrations were given at various places on the occasions of cattle and religious fairs, social and school meetings and in villages, etc. The advantages of these implements have now been realized in many parts, and the Department has been successful in convincing the zamindars of their usefulness. The heavy prices, however, are the

unsurmountable barrier, and it is now chiefly a commercial problem whether these can be supplied at cheap enough rates to suit the pockets of the ordinary cultivators.

Special mention may however be made of the demonstration and Agricultural Exhibition held during the cattle fair at Palwal, and at the time of Sikh Educational Conference at Delhi. Seeds of various crops and agricultural produce were exhibited, and the show of the Entomological Section attracted much attention.

Ploughing competitions were held at Jahazgarh, Rewari, Gurgaon and Palwal. The competition of Rajah plough at Palwal was a great success, and some 60 competitors turned out. Most of them were very good ploughmen and handled their implements with ease and confidence. The Deputy Commissioner, F. L. Brayne, Esquire, is to be congratulated at this achievement. The zamindars there use them regularly in preparing their lands. Five thousand, nine hundred and sixty bighas were ploughed with Raja plough there, before 9th December 1922.

In other parts of the circle, too, the implements sold are in use.

Great attention is now being devoted to concentrate demonstrations, and in some villages as many as 100 improved ploughs are at work.

The Meston plough in Ferozepore and Rajah plough in Gurgaon Districts are rapidly taking the place of the country ploughs. The District Board, Gurgaon, has consequently ordered 500 Rajah ploughs for resale and the Deputy Commissioner, Ferozepore, seeing the great popularity of the Meston ploughs and the eagerness of the cultivators to purchase them, has rightly obtained Government sanction to grant Taccavi for the purchase of these ploughs.

The sale of the implements has been quite large inspite of their heavy prices. The following is a list of the implements sold during the year:—

Rajah Ploughs	356
Meston Ploughs	155
Punjab Ploughs	3
Horse Hoes	3
Simplex Chaff cutters	4
Raja Fodder cutters	3
Little Marvel Ploughs	2
Raja Reaper	1
Lyallpur Drill	1
Imported shares for imported ploughs	145
Total ...	673

There are now over 1,500 improved implements in use purchased by the zamindars in this circle, and our Agricultural Assistants look after them, supply the necessary spare parts thereof, and train the owners or their men and remove their difficulties.

In addition to this there are 225 implements belonging to the Department that are lent out to zamindars for trial; who are also

trained to handle them, and the results of their achievement are carefully watched.

Demonstrations of Rajah Reaper were given at Durgapur in the Gurgaon District, and at Rohtak, Ismaila, Dhamar and Singhpura in the Rohtak District.

The winnower was shown at work at Jharsa in Gurgaon District. The country Phala Thrashers were also demonstrated in Gurgaon District where wheat is thrashed only under the feet of bullocks which is tedious and comparatively takes longer time.

Persian wheels and *Kharas* have also been introduced in Gurgaon District, and a wind mill is being put up near Gurgaon by the Agricultural Engineer for lifting water.

My sowing drill is complete, and has given satisfactory results both for Rabi and Kharif sowings.

The seed rate is uniform and ensures good and even germination. With its 5 drills behind 5 shares it saves labour and does 5 times the work ordinarily done by the zamindars with the same amount of labour. Besides it will enable the zamindar to increase his sown area as he will be able to command larger area when it is still in condition to be sown.

Machinery Depôts.—The opening of a much needed Machinery Depôt could not be undertaken as the very limited staff is already overworked, and it will not be consistent with efficiency to burden them any further.

Agricultural Associations.—There were 4 Agriculturral Associations in the circle, namely, Ferozepore, Rohtak, Karnal and Hissar. The Hissar Association is being reorganised.

Gurgaon District Board is keen to have an Association, but the work there is already beyond the control of one Agricultural Assistant posted there. An Agricultural Association, would do little good unless an Agricultural Assistant to look after the improved implements and test plots on the lands of the members could be provided.

Meetings of the Ferozepore, Rohtak and Karnal Associations were held. Some of the members are steadily engaged in the improvements of their agriculture, and are doing useful work. The occasional criticism of the work of Department by the public shows that they are awakening to the call of Agriculture, which is a very healthy and welcome sign.

Agricultural Farms.—Besides the Experimental Station at Hansi there are 3 other Demonstrarion Farms, *ie.*, Rohtak District Board Farm and Jallalabad and Guru Har Sahai Estate Farms (in Ferozepore District).

Detailed proposals for the Karnal and Gurgaon Demonstration Farms have already been submitted and the need of these farms is very urgently felt, as nothing carries so much weight with the cultivator as the actual growing of better crops near his own home. A thousand talks fail to convince him, when a single look at the crop is enough

to convert him. These farms serve as the centre of our propaganda work for the district.

The proposals for the bavani farm near Sirsa are also yet in the air.

Hansi Agricultural Station.—The details of the experimental work done at this station are embodied in a separate report.

The usefulness of the cotton selection work undertaken at this farm has already been mentioned above. Ten rectangles of Government waste land adjoining the farm have been added to it to grow seeds of the improved varieties of crops, which are in great demand in this locality.

Rohtak Demonstration Farm.—This small demonstration farm of 40 acres has served a very useful purpose, and is the nucleus of the agricultural activities that are going on in the district. The farm does not take upon itself the responsibility of experimental work, and confines itself to merely demonstrating such cultural methods as it is intended should be popularized in the district. Superior varieties of crops are grown side by side to the local ones, and offer very effective instructions and create an impression on the minds of zamindars that is not easily forgotten or ignored.

Seed rate trials there have gone a long way to show the futility of the high wheat seed rates prevalent in the locality.

Sugarcane trials with Co. 205 are also in progress there.

The financial results of the farm for the year under report are as follows :—

		Rs.	A.	P.
Income		1,929	10	1
Expenditure		1,569	3	9
Net profit		360	6	4

Considering that the expenditure includes the wages of labour, *i.e.*, Rs. 950 (which represents the farmers family on a private farm) and that prices of grain at the harvesting time were low, the results seem satisfactory; besides no one on a similar farm would entertain a demonstrator on Rs. 35 per mensem.

Jalalabad and Guru Har Sahai Estate Farms.—These farms continue to do good work in multiplying seeds of good varieties to supply their tenants and demonstrating the improved methods of agriculture. The former is very well managed, but unfortunately owing to the flooding of the farm no Rabi crops could be sown at all, and rice, the main Kharif crop, was damaged by the rice bug. The expenditure and income of the farms during the year are as follows —

Jalalabad Farm—

	Rs.	A.	P.
Income	4,499	6	9
Expenditure	4,628	13	8
Loss ...	129	6	11

Guru Har Sahai Farm—		Rs.	A.	P.
Income	...	2,202	9	1
Expenditure ...	...	2,031	14	3
Profit	...	170	10	10

Demonstration plots.—There are 40 demonstration plots in this circle and they have been very successful in demonstrating—

(*a*) Superiority of improved seed.

(*b*) Superiority of improved implements.

(*c*) Cultural methods.

(*d*) Improvement of soil by green manuring.

(*e*) Eradication of grasses by furrow turning ploughs.

(*f*) Sowing of crops in lines.

(*g*) Combating crop diseases and pests.

Statements showing the results of some of these plots are attached herewith.

Crop Diseases and Pests.

Earcockle in wheats.—This disease is prevalent in the Karnal District and does considerable damage. Demonstration plots showing that its cure is very simple and effective, was started in collaboration with the Economic Botanist.

The worm which causes the trouble is invisible to the naked eye but Microscopic demonstrations were given. This had great effect in convincing the neighbourhood of the real cause of this disease and a good many of the growers are having their seeds cleaned.

The Red Rot of Sugarcane experiment conducted by the Economic Botanist at Ferozepore has clearly shown the usefulness of growing disease free canes. Healthy seed was accordingly obtained from Muazzim and sent out to Ferozepore and Dharamkot where it is grown for multiplication, and will be distributed at the following sowing season :—

Rust.—Owing to the cloudy and moist weather during January rust made appearance in all quarters and did damage to the wheat crop.

Rice Bug has done very great damage in most of the rice growing tracts of this circle. Bagging was recommended and demonstrated.

There are only 6 Agricultural Assistants and 8 Makaddams (including those under District Board service), on district work.

The work done by this handful of pioneers in such a vast and backward circle, in face of many initial difficulties (please see Khan Sahib Maulvi Fateh-ud-Din's report on this circle for the last year), the huge area under our improved seeds (there are 62½ thousand acres under wheats and 35 thousands under Desi cottons besides areas under various other crops), the thousands of improved implements in use,

handling of thousands of maunds of produce for distribution and marketing, the hundreds of demonstrations given, maintenance of large number of demonstration plots, combating crop pests, attending needs of zemindars, maintaining Seed Depôts and their accounts show the enthusiasm, the zeal and the energy with which the work has been tackled. The results achieved do credit to them. The work has however now expanded to an extent that it is getting beyond the control of the Deputy Director alone and an Extra Assistant Director of Agriculture is the immediate and an urgent need of this circle.

Among the District Assistants Bhai Sucha Singh, Agricultural Assistant, Ferozepore, Chaudhri Sarup Lall, Agricultural Assistant, Rohtak, have done exceedingly well. Chaudhri Diwan Chand has done good work in connection with the cotton sale arrangements.

The Honorary Leiutenant Rao Bahadur Chaudhri Lal Chand, Vice-Chairman, District Board, Rohtak, has taken great interest in the Demonstration Farm, Rohtak, as well as in the Agricultural Association, and the success there is greatly due to his personality.

My sincere thanks are due to F. L. Brayne, Esquire, Deputy Commissioner, Gurgaon, who has taken keen interest in all matters concerning Agricultural developement of his district and has pushed the work with great ardour. Indeed our success in that District is due to his assistance.

The 30th July 1923. DARSHAN SINGH OF VAHALI,

Deputy Director of Agriculture,

2nd Circle, Hansi.

Statement showing the results of white flowered Negletum (Hansi Selection) Bhatla Selected tried at various Demonstration Farms against other cotton varieties.

Serial No.	Name of Variety.	Area of the plot	Actual outturn. M.	S.	Ch.	Outturn per acre. M.	S.	Ch.	Order of merit	Remarks.
	Beas (Amritsar District) District Board Farm.									
1	White flowered Neglectum Bhatla Selected 74.	¼ acre	1	37	6	7	29	8	I	
2	Mollisonea ...	¼ acre	1	26	13	6	27	4	II	
3	Sanguineum ...	¼ acre	1	22	11½	6	10	14	III	
	Seed Farm, Sargodha.									
1	White flowered Neglectum Bhatla Selected.	5,454 sq.ft.	1	10	0	10	0	0	I	Crop was attacked by root rot.
2	Ditto ...	4,695 sq.ft.	0	34	9	8	0	10		
3	Sanguineum ...	34,228 sq. ft.	7	29	11	9	34	8	II	
4	Rosea, No. 40 ...	29,245 sq. ft.	6	22	10	9	31	0	III	
5	Mollisonea, No. 22 ...	32,826 sq. ft.	7	11	1	9	26	0	IV	
6	Khanna ...	32,579 sq. ft.	6	34	6	9	7	0	V	
	Agricultural Farm at Khalsa College, Amritsar.									
1	White flowered Neglectun Bhatla Selected.	...	...	..	...	8	24	0	I	
2	Ditto ...	II plot.	...	...	...	7	35	2		
3	Mollisonea ...	...	...	...	...	6	5	2	II	
4	Ditto ...	II plot	...	...	...	6	4	0		
5	Ditto ...	III plot	...	...	...	5	3	0		

Statement showing sale in the Hansi Circle of Improved Agricultural implements during the year ending 30th June 1923.

Imported Implements.		Implements Manufactured by the Punjab Agricultural Department.		Implements Manufactured in India.	
Name of implement.	No. sold.	Name of implement.	No. sold.	Name of implement.	No. sold.
Rajah Ploughs	356	Lyallpur Drill	1	Imitation	...
Meston Ploughs	155	Bar Harrows	...	Meston Ploughs made in Punjab	...
Punjab Ploughs	3	Drills	...	Ditto Do. India	...
Horse Hoes	3	Lyallpur Hoes	...	Elsewhere than Punjab ...	...
Fodder Cutters :—				Shares for both	...
Simplex ... 4	7			Nahan Sugar Crushing Mills ...	...
Raja ... 3					
Little Marvel Ploughs	2				
Raja Reaper	1				
Imported shares for imported Ploughs	145				
Total ...	672		1		...

Statement showing the detail of Demonstrations carried out in the Hansi Circle during the year ending 30th June 1923.

Date.	Name of place.	Name of implements or object of demonstration.	Remarks.
		I—FEROZEPORE DISTRICT.	
14th July 1922 ...	Baggeki Pipal ...	Meston Plough ...	Eradication of Dab grass.
24th July 1922 ...	Dumewala ...	Ditto ...	Ditto.
26th July 1922 ...	Darauli ...	Ditto ...	Ditto.
28th July 1922 ...	Bankhandi ...	Ditto ...	Ditto.
20th August 1922 ...	Jai Singh Wala ...	Ditto ...	Ditto.
3rd September 1922...	Ghillu ...	Ditto ...	Ditto.
10th September 1922	Zira ...	Raja Plough ...	Ditto.
15th September 1922	Telupura ...	Ditto ...	Ditto.
27th September 1922	Zira ...	Meston Plough ...	Ditto.
Ditto	Banke Kalan ...	Ditto ...	Ditto.
29th October 1922 ...	Ferozepore ...	Ditto ...	Ditto.
10th January 1923 ...	Karyan ...	Ditto ...	Ditto.
6th February 1923 ...	Sohe Kadyan ...	Ditto ...	Ditto.
7th February 1923 ...	Sultan Khan Wala...	Ditto ...	Ditto.
13th February 1923...	Mulwal ...	Ditto ...	Ditto.
18th February 1923...	Masur Deva ...	Ditto ...	Ditto.
19th February 1923 ..	Botianwala ...	Ditto ...	Ditto.
Ditto	Malsian ...	Ditto ...	Ditto.
Ditto	Santuwala ...	Ditto ...	Ditto.
Ditto	Muzim ...	Ditto ...	Ditto.
20th February 1923 ...	Asafwala ...	Ditto ...	Ditto.
24th February 1923...	Faqarsar ...	Ditto ...	Ditto.
2nd March 1923 ...	Hasteke ...	Ditto ...	Ditto.
3rd March 1923 ...	Sahoke ...	Raja and Meston Ploughs.	Ditto.
6th March 1923 ...	Walaur ...	Ditto ...	Ditto.
12th March 1923 ...	Bajeke ...	Ditto ...	Ditto.
9th April 1923 ...	Panj Kosi ...	Meston Plough ...	Ditto.

Statement showing the detail of Demonstrations carried out in the Hansi Circle during the year ending 30th June 1923—continued.

Date.	Name of place.	Name of implements or object of demonstration.	Remarks.
	II—KARNAL DISTRICT.		
9th July 1922 ...	Tikri ...	Horse Hoe ...	Hoeing of cotton.
13th August 1922 ...	Sertha ...	Meston Plough ...	
27th September 1922	Charas ...	Meston and Raja Ploughs.	
24th September 1922	Karnal ...	*Anti*-rice hey Compaign.	
26th September 1922	Niawal and Baragaon	Ditto ...	
6th October 1922 ...	Padhana ...	Raja and Meston Ploughs and Lyallpur Drill.	
11th October 1922 ...	Gharaunda ...	Ditto ...	
6th and 7th December 1922.	Kunjpura and Nalwi Khurd.	Raja and Meston Ploughs, Chaff cutter and Horse Hoes.	
14th December 1922	Ucha Samana ...	Ditto ...	
15th December 1922	Mubarakabad ...	Ditto ...	
19th January 1923 ...	Barsham ...	Ditto ...	
23rd January 1923 ...	Sangoi ...	Raja and Meston Ploughs.	
25th February 1923...	Shahabad ...	*Anti*-rat Compaign.	
1st May 1923 ...	Karnal ...	Meston and Raja Ploughs.	
15th May 1923 ...	Do. ...	Ditto ...	
	III,—AMBALLA DISTRICT.		
2nd and 3rd June 1922.	Nagal ...	All implements.	
10th June 1922 ...	Pusiala ...	Meston Plough.	
11th June 1922 ...	Raomajra ...	Ditto.	
12th June 1922 ...	Ogala ...	Ditto.	
4th to 9th June 1922	Bihta ...	Rajah Plough, Horse Hoe and Meston Plough.	
10th August 1922 ...	Sadhaura ...	All implements.	
11th August 1922 ...	Do. ..	All implements for students only.	
18th August 1922 ...	Harri ...	Meston Plough.	
Ditto ..	Kalpi ...	Ditto.	
19th August 1922 ...	Nauhoni ...	Ditto.	
21st to 23rd December 1922.	Chamkaur Sahil ...	All implements.	
29th December 1922	Nagal ...	Ditto.	
17th and 18th January 1923.	Sadhaura ...	Ditto.	

Statement showing the detail of Demonstrations carried out in the Hansi Circle during the year ending 30th June 1923.

Date.	Name of place.	Name of implements or object of demonstration.	Remarks.
	III.—AMBALA DISTRICT—concld.		
28th February 1923...	Rupar ...	All implements	
9th March 1923 ...	Bilha ...	Ditto.	
24th and 25th March 1923.	Mansa Devi ...	Ditto.	
	IV.—ROHTAK DISTRICT.		
17th to 19th March 1923.	Jahazgarh ...	All implements.	
Different dates ...	Ismila ...	Demonstration of Raja Reaper.	
	Dhamar ...	Ditto.	
	Singhpura ...	Ditto.	
	V—HISSAR DISTRICT.		
July 1922 ...	Narnaund ...	Horse Hoe ...	Hoeing of cotton.
Do. ...	Jamauri ...	Ditto ...	Ditto.
Do. ...	Sisai ...	Ditto ...	Ditto.
Do. ...	Bhatla ...	Ditto ...	Ditto.
Do. ...	Milahpura ...	Ditto ...	Ditto.
20th to 23rd July 1922.	Jamauri ...	Raja Plough.	
5th and 6th August 1922.	Pali ...	Ditto.	
26th and 27th September 1922.	Hansi ...	All implements at the occasion of cattle fair.	
25th to 27th March 1923.	Hansi ...	Ditto.	
	VI—GURGAON DISTRICT.		
	100 Demonstrations of Raja Ploughs were given in the district during the year. Each Demonstration attracted a large gathering of people. At several occasions prizes were awarded to the Zamindars in the competition.		
	VII—DELHI PROVINCE.		
	Delhi—		
29th July to 6th August 1922.	All implements at the Educational Conference,	Occasion of Sikh Education Conference, Delhi.	
17th and 18th February 1923.	Khera Garhi ...	All implements.	
20th January 1923 ...	Delhi ...	Raja Plough competition.	

Results of Demonstra-

Serial No.	Name of place.	Object of Demonstration.	Area sown.	
			Improved method.	Local system.
1	Samalkha (District Karnal).	Earcockle Demonstration plot with wheat.	8-A cleaned 544 square yards.	Mixed with galls. 544 square yards.
	Ditto	Ditto	Ditto	Ditto.
	Panipat (District Karnal)	Ditto	16-A cleaned 847 square yards.	Local without cleaning 847 square yards.
	Ditto	Ditto	8-A clean. 847 square yards.	Local mixed with galls. 847 square yards.
2	Narnaund (District Hissar).	Wheat 8-A tried against Local Punjab 14.	8-A 12-K. Bighas.	Punjab 14, 12-K Bighas.
3	Hansi (District Hissar)...	Seed rate trials with 8-A.	...	...
		25 seers per acre	2 Bighas	...
		30 seers „	Do.	...
		35 seers „	Do.	...
4	Azimgarh (Ferozepore District).	Sowing cotton in lines and interculture with Lyallpur hoe *versus* Local system.	1 Acre	1 Acre.
	Boring Khera (Ferozepore District).	Ditto	3 Acres	3 Acres.
	Rania (Ferozepore District).	Ditto	1 Acre	1 Acre.
	Zira (Ferozepore District)	Ditto	1 Acre	1 Acre.
	Laugiana (Ferozepore District).	Ditto	4 K.	4 K.
	Ghall Kalan (Ferozepore District).	Ditto	4 K.	4 K.

tion Plots.

Actual outturn.						Outturn per acre.						Difference of outturn per acre.			
Improved method.			Local system.			Improved method.			Local system.						
M.	S.	Ch.	M.	S.	Ch.	M.	S.	Ch.		S.	Ch.	M.	S.	Ch.	
1	14	0	0	18	0	13	0	2	4	18	7	+8	26	11	
1	10	0	0	17	0	12	1	10	4	3	12	+7	37	14	
1	12	1	1	1	15	7	17	8	5	30	1	+1	27	7	
1	10	0	0	37	18	7	5	11	5	16	1	+1	29	10	
55	0	0	38	0	0	22	0	0	15	8	0	+6	32	0	
...	...		...	...	...	...	...	...	...	...	...	...	...	...	
8	20	0	...	...	...	20	16	0	...	...	...	...	...	...	
9	10	0	...	...	...	22	8	0	...	...	...	M. S. C. 3 9 12			More than in the case of 35 seers.
7	36	0	...	...	...	18	38	4	...	...	...	...	...	...	
15	0	0	13	20	0	15	0	0	13	20	0	+1	20	0	White flowered Neglectum Bhatia selected.
27	21	8	21	30	0	9	7	2	7	10	0	+1	37	2	4-F.
9	20	0	3	15	0	9	20	0	3	15	0	+6	5	0	
11	0	0	4	0	0	11	0	0	4	0	0	+7	0	0	
4	20	0	3	0	0	10	35	0	7		0	+3	25	0	
2	20	0	Failed.			4	32	0	Failed.			+4	32	0	

Serial No.	Name of place.	Object of Demonstration.	Acre sown.	
			Improved method.	Local system.
5	Buttar (Ferozepore) ...	Maize sown in lines and interculture with hand hoe *versus* local system.	2 Acres	2 Acres.
	Ghall Kalan (Ferozepore)	Ditto	1 Acre	1 Acre.
6	Rania (Ferozepore) ...	8-A Wheat *versus* Local	*8-A.* 25 Acres	Local 25 Acres.
	Suhe Kadyan (Ferozepore)	Ditto	1 Acre	1 Acre
	Karyan (Ferozepore) ...	Ditto	5 Acres	5 Acres
	Ghall Khurd (Ferozepore)	16-A Wheat *versus* Local.	*16-A.* 9-K.	8-K.
7	Bagapurana (Ferozepore)	Green manure (San hemp) *versus* unmanured.	1 Acre	1 Acre
	Baring Khera (Ferozepore).	Ditto	10 Bighas	10 Bighas
	Chak Maha Badar (Ferozepore).	Green Manure (Gowar ploughed in) *versus* Unmanured.	15 Acres	15 Acres
	Dugar Khera ...	Green manure (Gowara) ploughed in *versus* Unmanured.	12 Bighas	12 Bighas
8	Bhalaut (District Rohtak)	Dab Reclamation Demonstration Plot (Gram) *versus* Local system.	10 Bighas	12 Bighas
	Basantpur (District Rohtak).	Ditto	12 „	14 „
	Daryapur (District Rohtak).	Ditto	20 „	20 „
	Ismila (District Rohtak)	Ditto	25 „	22 „
	Bohar (District Rohtak)	Dab Reclamation Demonstration Plot (chari-fodder) *versus* local system.	4 „	3 „

tion Plots—concluded.

Actual outturn.						Outturn per acre.						Difference of outturn per acre.			
Improved method.			Local system.			Improved method.			Local system.						
M.	S.	Ch.	M.	S.	Ch.	M.	S.	Ch.	M.	S.	Ch.	M.	S.	Ch.	
49	0	0	37	0	0	24	20	0	18	20	0	+6	0	0	
13	0	0	12	0	0	13	0	0	12	0	0	+1	0	0	
350	0	0	300	0	0	14	0	0	12	0	0	+2	0	0	
14	0	0	10	0	0	14	0	0	10	0	0	+4	0	0	
80	0	0	70	0	0	16	0	0	14	0	0	+2	0	0	
9	13	5	7	31	2	10	1	9	9	16	2	+0	25	7	
19	0	0	12	0	0	19	0	0	12	0	0	+7	0	0	
105	0	0	82	20	0	16	37	9	13	12	6	+3	25	3	
180	0	0	150	0	0	12	0	0	10	0	0	+2	0	0	
36	0	0	60	0	0	5	0	0	8	0	0	−3	0	0	Crop failed.
36	0	0	24	10	0	17	4	0	9	28	0	+7	16	0	
45	0	0	25	10	0	17	32	8	8	22	10	+9	9	14	
60	20	0	42	10	0	14	14	12	10	1	6	+4	13	6	
110	0	0	40	20	0	20	36	0	8	29	9	+12	6	7	
375	*pulies*			*Nil*		445	*pulies*			*Nil*		+445	*pulies*		

PRINTED BY THE
SUPERINTENDENT, GOVERNMENT PRINTING, PUNJAB.
25 DA—391—4·2·24—SGPP Lahore.

00134234

Digitized with financial assistance from

Government of Maharashtra

on 01 February, 2020